# The Dock & Harbour Authority



No. 437. Vol. XXXVII | MARCH, 1957 | Monthly 2s. 6d.

# Libya Clears up War's Debris

## Dredges mud and mortar-bombs the Priestman way

The North African Ports received their full share of military attacks during the late war and, as the tide of battle swept back and forth, its debris accumulated as neither side was able or willing to carry out dredging operations.

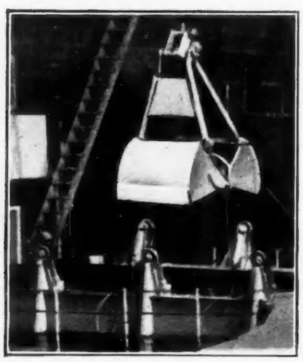
Faced with the problem of dredging its harbours the newly formed Government could not, for economic reasons, purchase its own equipment, but the Admiralty were able to offer assistance by sending one of their grab dredgers to carry out a certain amount of work in Tobruk and other ports.

As soon as circumstances permitted the Libyan Government allocated funds for the purchase of dredging equipment and without hesitation chose grab dredgers.

The wide variety of materials, from mud to mortar shells and from broken rocks to bombs, are all good reasons for this choice as no other type of dredger could, economically, handle them.

Priestman Brothers Limited of Hull were accordingly commissioned to supply a Single-Screw Diesel-driven Grab Hopper Dredger for service in the Libyan ports on the Mediterranean coastline, and in turn commissioned the well-known Leith shipbuilders, Henry Robb Limited, to build the vessel; themselves supplying the basic dredging equipment.

The vessel, the Annahda, is of the single flush deck type arranged with machinery aft, the hopper approximately amidships and the dredging crane forward.



*The Priestman Grab fills the 275-ton hopper in 88 minutes with a wider variety of spoil than could economically be handled by any other type of dredging equipment.*

The dredging crane is of the Priestman No. 50 size, driven by a 100 b.h.p. diesel engine and operates either a 70 cu. ft. Mud, a 55/44 cu. ft. Sand, or a 32/28 cu. ft. Wholetine Rock Grab at depths down to 50-ft. 0-in. below water-level.

Principal Dimensions of the "Annahda."

| | | | |
|---|---|---|---|
| Length between perpendiculars ... | 110′ 0″ | Draft loaded, mean ... | 9′ 0″ |
| Breadth moulded ... | 29′ 0″ | Hopper capacity, tons | 275 |
| Breadth overall ... | 30′ 6″ | Oil fuel capacity, tons | 20 |
| Depth moulded ... | 10′ 6″ | Engine b.h.p. ... | 420 |
| | | Engine r.p.m. ... | 320 |

On trials the 275-ton hopper was filled in 88 minutes from a depth of about 30-ft. 0-in. in a mixture of mud and shells.

The main propelling machinery consists of a Crossley two-stroke cycle oil engine developing 420 b.h.p. at 320 r.p.m. and on trials a speed of 9.33 knots was attained against a contract speed of 8.5 knots. The deck machinery is all electrically driven with the exception of the steering gear which is hydraulically operated. Two auxiliary engines are situated in the engine room each driving a 15 kw. generator and the necessary air compressors and general service pump. An electrically-driven fuel oil transfer pump is also fitted.

Accommodation is provided for a total of 11 men, part of this being arranged forward and part aft on the main deck. A saloon and galley are built aft alongside the machinery casings and the necessary toilet facilities are provided.

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The Dock & Harbour Authority

An International Journal with a circulation extending to 85 Maritime Countries

No. 437

Vol. XXXVII

MARCH, 1957

Monthly 2s. 6d.

# Editorial Comments

**The Port of Iskenderun.**

Until the Second World War the Port of Iskenderun, situated in Turkey in Asia, was comparatively unimportant. Following the outbreak of hostilities, however, the strategic importance of the area became increasingly apparent, as the western side of Turkey was right against Axis territory, being on the Bulgarian border which was under German influence and had contingents of German troops stationed there. It was therefore realised that, in the event of an invasion of Turkey by Axis forces, the Allies would have been denied the use of Istanbul (Constantinople), so that the only point where Allied forces could have gone to the assistance of Turkey would have been from the south-east of the country, and Iskenderun, if suitably developed, would provide the alternative base.

Accordingly, following consultations between the two countries, the British authorities agreed to assist the Turkish Government in their development plans in that area and, in 1941, a scheme was put in hand to carry out improvements in the old harbour and to construct a new jetty and other ancillary works. All these improvements, described in detail on a following page, were completed entirely under British direction with Turkish labour, and, owing to the unsettled conditions prevailing at the time, the work was carried out under considerable difficulties.

Since the war, there have been further developments at the port and, in particular, modern bulk handling facilities have been installed to cope with the increasing output of agricultural and mineral products from the south-eastern provinces of Turkey. Readers will recall that these new plants have been described in recent issues of this Journal.

Another development which could have considerable significance in view of the prevailing uncertainties concerning oil supplies from the Middle East, is the proposal to make Iskenderun an oil shipping port. It has been suggested that a pipe line should be built from the north of Iraq to Iskenderun, thus bypassing the Suez Canal.

**Occupational Hazards in the Stevedoring Industry.**

One longshoreman out of two was injured whilst at work during 1954 and one out of six suffered a disabling injury at an estimated total cost for the year of $70,000,000, according to a study recently released by the Maritime Cargo Transportation Conference of the National Academy of Sciences — National Research Council, U.S.A. The study, entitled "Longshore Safety Survey, A Survey of Occupational Hazards in the Stevedore Industry," emphasises the human element in current cargo handling methods and the need for increased protection of the workforce. It also reveals the economic importance of longshore safety to the shipping industry.

The study points out the hazardous nature of stevedore employment and recommends appropriate action to be taken by labour, management, and the Federal Government to reduce the accident frequency rate. The publication reports that the majority of longshore accidents are attributable to the human factor and unsafe working practices within a relatively dangerous materials handling system. It suggests that longshore hazards can be sharply reduced by (a) positive and unremitting safety education by both management and unions; (b) improved materials handling methods; (c) increased mechanisation, particularly in the hold, and (d) attention to proper design of facilities and cargo handling gear.

The industry has made considerable safety progress over the past two decades, but according to the report (much of which is reproduced on a later page of this issue) it still has a long way to go towards effective control of the injury frequency rate. The Bureau of Labour Statistics reported an injury frequency rate of 12 per million manhours worked for all manufacturing in 1954 as compared with a rate of 92 for stevedoring. This relatively high rate in the stevedoring industry is attributed in large measure to the failure of labour and management to meet their basic responsibilities in the area of accident prevention. The report points out that where effective safety programmes have been undertaken in the industry, quick and dramatic improvements have been attained. In some instances the accident frequency rate was brought down below 20.

**Ships and Nuclear Power.**

There are many subjects dealt with in the annual report of the Chamber of Shipping of the United Kingdom which are of interest to dock authorities. Indeed it may be said that almost anything that affects shipping is in some way associated with docks and harbours. Thus such matters as pollution of the air by smoke and of the water by oil, the carriage of dangerous goods, explosives indemnities, food and drugs legislation, harbour bye-laws and pilotage can all be of mutual concern to those whose business it is to operate ships at sea or in port. Perhaps, however, nuclear power in relation to merchant shipping claims special attention. In the report reference is made to the fact that although the technical feasibility of nuclear power for marine propulsion has already been proved by the American submarine "Nautilus," its economic feasibility for merchant ship purposes has yet to be established. At the same time it is pointed out that only recently the United States Maritime Administration asked seven yards in that country to submit specifications for the building of a 15,000-ton atomic passenger-cargo ship at a cost estimated at £15,000,000, and reference is made to the suggestion that this country is five years behind America and Russia in the application of nuclear power to marine propulsion. British shipowners, it is stated, recognise that if the necessary research is to be pressed forward with the speed demanded by national considerations, the cost may well be beyond the resources of the shipping and shipbuilding industries. There is a clear hint to the Government in the reminder that most of the State-sponsored research into propulsion in this country has been in the aircraft industry.

In the expectation that American atomic-propelled ships may in the not too far distant future be calling at British ports, members of both Houses of Parliament have been urging that the time is already ripe for special safety regulations to be considered in regard to, for example, the disposal of atomic waste when such ships are in harbour, and to the dangers inherent in the fracture of an atomic engine casing or of the shielding, with the release of radio-active material which would be dangerous to life, especially in populous areas such as adjoin the Thames and the Mersey. The view has been expressed that there should be an inter-

## *Editorial Comments—continued*

national code of regulations governing circumstances such as these. All the points at issue are of importance to dock authorities, so that the intimation that British shipowners have a "quickening interest" in nuclear propulsion, as indicated by their representation on the Atomic Energy Sub-committee of the British Shipbuilding Research Association, and by their intention to keep in touch with developments through Lloyd's Register of Shipping (which has many contacts with the United Kingdom Atomic Energy Authority) is of considerable significance. The announcement, too, of the intention of the Government to set up a committee representing the Admiralty, shipowners, shipbuilders and marine engineers to go into the whole question of atomic energy in relation to ships would seem to imply that if suitable reactors are not "just round the corner" they may be, to mix the metaphor, on the horizon.

Extracts from the Chamber of Shipping report will be found on page 381.

**Further Enquiries into the Problem of Dock Labour.**

Attempts to solve the problem of providing an efficient and contented labour force are being made in some part of the world every day. Its urgency alone keeps it in the public eye.

No discussion on ship turn-round, cargo handling methods, or port construction and facilities, is of much value if the factor of dock labour is not covered. At the present time, the findings and recommendations of a commission of enquiry into port working in Colombo are being considered by the Government of Ceylon. The commission reports, among other things, "a lamentable deterioration in the labour situation" and it is recommended that strikes and lock-outs, including go-slow movements, should be prohibited in the port in the interests of the nation's economic survival. This step, however, would be subject to certain safeguards being adopted and new machinery being created for the settlement of labour disputes.

As we go to press, the sixth session of the I.L.O. Inland Transport Committee is being held in Hamburg, Germany. The meetings will last from the 11th to 23rd March, and the discussions will largely be based on a report by the I.L.O. Secretariat, which is, of course, much concerned with the dock labour problem. Extracts from both the Colombo enquiry and the I.L.O. Report will be found on later pages in this issue.

Most of the enquiries into dock labour problems during recent years show that the employer-employee relationship is usually considered of the utmost importance. Although this relationship is often partly controlled by the terms and conditions of local Labour Schemes, there is no doubt that another factor is that the quality of such a relationship depends largely upon the kind of people representing the employers and the employees respectively. Do employers, when making appointments, pay sufficient attention to the ability of their supervisory staff to control and to get the best out of the gangs who work for them? Do the methods of obtaining union officials result in the appointment of men of the right calibre for this extremely delicate though arduous job? Such a great deal depends on the personal touch, that these matters are extremely important.

**The Problem of Economical Timber Handling at Ports.**

In our editorial comments for October last, reference was made to the very successful Timber Handling Conference which was held at Manchester the previous month. At that time, we stated that in view of the importance of the subject, we hoped from time to time to publish articles on different aspects of timber handling problems. We would, therefore, bring to the notice of our readers the article on page 367, by Mr. A. Gourvitch, managing director of the Phoenix Timber Co. Ltd. The author has posed a number of controversial questions which will be of considerable interest to members of the timber trade and also to many port authorities. It is hoped to follow this article with further contributions in due course.

# Timber Engineering

## The Development of a New Industry

On February 12th last, a meeting was held in London to mark the establishment in the United Kingdom of the new industry of timber engineering. The meeting, presided over by Major Bruce B. Kennedy, Chairman of the Timber Development Association, was supported by some eighty member companies of the Association, all of whom specialise in the fabrication of engineered timber structures.

In view of the volume of requests for designs and information which have been received by the Timber Development Association and the manufacturing companies over the past few years, it has been clear for some time that there is a large unsatisfied demand for economical and quickly erected roof structures and building frameworks for public and industrial buildings. At the meeting, arrangements were considered to put at the disposal of the building and civil engineering industries a country-wide organisation, backed by the accumulated experience in the special problems of engineering design in timber and by the research and testing facilities offered to industry by the T.D.A.

The years since the war have seen great strides in the development of timber as a material for structural engineering, and it is now possible to design and build timber structures of the largest size, which are competitive in cost and performance with conventional building materials such as steel and concrete. To a certain extent, knowledge of the properties of timber has over the years been neglected, and it was not until the shortages of metal due to the demand for armaments was experienced that research into the properties of timber was stimulated.

It is not generally appreciated that in stiffness timber is stronger weight for weight than aluminium, steel or concrete, and in bending and tension takes second place to aluminium. These are very important factors in relation to present-day requirements for industrial buildings. The ideal building in which to carry out industrial processes is one in which the number of supporting columns has been reduced to a minimum and in which central columns are non-existent. For such buildings, where stiffness is the prime requisite, a low density material such as timber which possesses very favourable strength/weight properties, can be used to advantage.

Already numerous industrial buildings in timber have been erected and these have proved economical in first cost. One of the developments in technique which have made these engineered timber structures possible is that of the timber connector, a metal plate or ring placed round a bolt between adjacent pieces of timber. In the past serious limitations in the strength of timber joints restricted spans, but now timber connectors of various forms, capable of transmitting considerably increased loads, are widely used and clear spans of 120-ft. have become a fact.

Adhesives also have a great future in relation to timber structures. These adhesives are to timber what welding is to steel. Some of these glues are completely water resistant. Such glued structures are permanent, and give to the designer constructional forms which are now associated with glued laminated timber construction.

In coastal districts, and in areas where atmospheric pollution occurs as well as in dye houses and chemical works, timber is of particular value. It does not deteriorate as a result of the action of salt, and it withstands very well the effect of chemicals from the atmosphere. Thus, the heavy and recurring maintenance charges, which are often a necessity in such environments, are very considerably reduced.

On a question of fire it should be remembered that timber is a good insulator and does not melt or tend to creep with increasing temperature; furthermore its thermal expansion and contraction is negligible. Thus in a fire it does not tend to expand and weaken masonry and the roof members remain in position carrying their load for an appreciable time. Loss of strength eventually occurs, due to the reduction of the cross section and is proportional to this loss.

# The Port of Iskenderun

## British Development of Turkish Harbour

*(Specially Contributed)*

THE story of the development of the Iskenderun Harbour has never been fully told. The reason for this silence lies, firstly, in the fact that important new construction and modernisation was carried out between 1941 and 1945 and was, therefore, subject to the security cloak imposed during the war. Secondly, it was thought at the time that once peace was established these improvements, like so many other semi-military projects, would be allowed to decay in idleness due to lack of adequate civilian need. This view proved incorrect.

Immediately after the war, neither the Ports of Western Turkey nor the Turkish Railways were in a position to handle the increasing imports into the country, many of which were destined for the Eastern part, so that some had to be diverted to Iskenderun. At the same time the development of farming and mining in South East Turkey produced an exportable surplus, notably of wheat and chrome, whose natural outlet to foreign markets was again Iskenderun.

To meet the increasing demand being made upon the port, large new developments are being planned and executed (such as the modern conveyor systems described in the September 1956 and February 1957 issues of this Journal). It is appropriate, therefore, that the work done during the war years, which proved to be the foundation of this further expansion, should be described. This work does credit to the British ability to build well under difficult conditions and to the foresight of the Turkish Authorities who asked that peace-time as well as war-time needs should be considered.

### HISTORY

Iskenderun, or Alexandretta as it was called prior to its acquisition by Turkey in 1939, was the natural outlet for Northern Syria of which the commercial centre was Aleppo. A small port had been developed, largely by the French, to meet the needs of the area but by 1939 it was becoming inadequate and the Turkish Ministry of Public Works was considering extension. They had in mind a small jetty built from the shore line in the bay to the North of the existing harbour and the development of rail access, interchange yards and transit sheds not available in the then existing port area.

The relative positions of the old and the new works are shown in the plan (Fig. 1). It was not considered that unloading at the new jetty would be seriously interrupted by weather conditions but provision was made in the scheme for a breakwater commencing at a point to the west of the old harbour, to be built at a later date if necessary.

Towards the end of 1940, the British Authorities began to take an interest in Iskenderun as a point of entry for supplies to Turkey and they, through the United Kingdom Commercial Corporation, approached the Turkish Ministry of Public Works with a suggestion that its scheme should be adapted to meet war-time needs. At that time the only contractor in the country with the plant, resources and experience necessary to undertake the design and construction was Braithwaite and Co. Engineers Ltd. who had just finished the construction work at the Karabuk Iron and Steel Works. They were called in as technical advisers.

Negotiations were brought to a satisfactory conclusion in August 1941 and a contract was signed with Braithwaite in November the same year for the execution of the work which was divided broadly into three parts:

(a) Reconstruction work in the old harbour including resurfacing the south quay and building a sheet pile quay along the East breakwater.
(b) Putting in a railway siding from Ak Cay Station to the old harbour and arranging a marshalling yard alongside it between Ak Cay Station and the new jetty.
(c) The construction of the new jetty with its offices, transit sheds and rail connection to the marshalling yards.

It is with the last that this article is concerned.

To safeguard their interests the Turkish Ministry of Public Works and the British Military Authorities appointed resident engineers at site and later the United Kingdom Commercial Corporation arranged for Sir Alexander Gibb and Partners to send out a resident engineer and assistant to exercise technical supervision on their behalf.

Although the above might seem a cumbersome organisation it functioned very smoothly in practice and facilitated contacts with outside authorities in the complicated supply problems. These will be mentioned later.

### SITE CONDITIONS

Iskenderun in 1941 was a sleepy little town with very little reserve of housing or industrial capacity and in consequence it was necessary that the construction site should be largely self-supporting. Much of the labour had to be recruited from distant villages and arrangement made at site for feeding and housing.

Prior to 1938 the main movement of goods in and out of Iskenderun was over the roads running east to Syria, movement into Turkey to the North being difficult due to marshes between the sea and the hills running parallel to it a few miles inland which extended as far as Ak Cay Station. In 1940 this marshland was crossed by a single-track railway line built on an embankment and there was a road running along the edge practically on the seashore. Most of the land works to be described later had to be built on areas reclaimed from the marsh.

The tide range, as in all the Eastern Mediterranean was only about 18-in. but use of floating plant was difficult as at certain times of the year a wind sprang up each afternoon and whipped up a choppy sea before dying away at sunset. This problem was overcome by working double shifts on the floating plant with a sufficient gap between them to bridge the rough period.

Otherwise weather conditions were reasonable except for periods in summer when low cloud accumulated over the swamps lying between the coast and the hills. Temperature and humidity were then high and working conditions difficult.

A limited supply of electric power was available from the Iskenderun town powerhouse but the generating plant was old and unreliable as great difficulty was experienced in getting the necessary spares. The power needed for the construction had therefore to be made available largely from Braithwaite's own resources.

Borings that had been made along the line of the jetty indicated that the sea bed was soft silt or mud overlying a harder sandy strata which was close to the surface near the shore. At many points borings penetrated a depth of 25m. below the sea bed without encountering the hard strata.

Near the shore the hard stratum contained stones and debris from unloading lighters as well as a sunken barge loaded with reinforcing bars.

### DESIGN

**General**

The specification agreed with the various authorities provided for the following:

(a) Berth for two ships of about 13,000 tons with a minimum depth of water of 30-ft.
(b) Four six-ton quayside cranes, two on each side for expeditious unloading of the cargo and one 25-ton fixed crane at one corner for heavy loads.
(c) A super-imposed load of 3-tons per square foot plus railway loading of a heavy engine and five wagons with a total weight

## *Port of Iskenderun—continued*

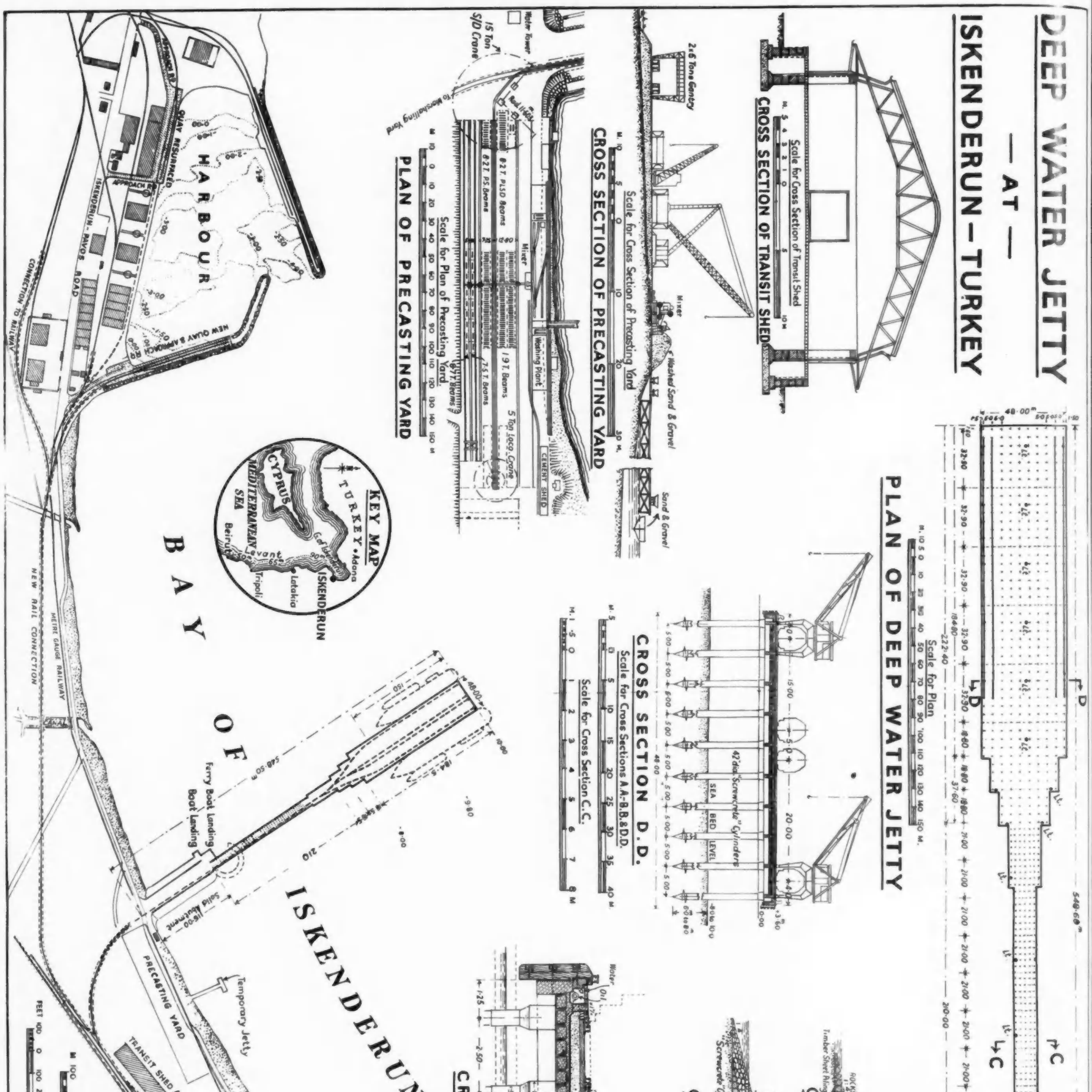



Fig. 1. Showing 1 (at bottom) Relative position of old and new works; 2 (top right) Plan of deep water jetty; 3 (top left) Cross-section of transit shed; 4 (in centre and on right) Cross-sections A—A, B—B, C—C and D—D; 5 (left centre) Plan and cross-section of precasting yard.

## *Port of Iskenderun—continued*

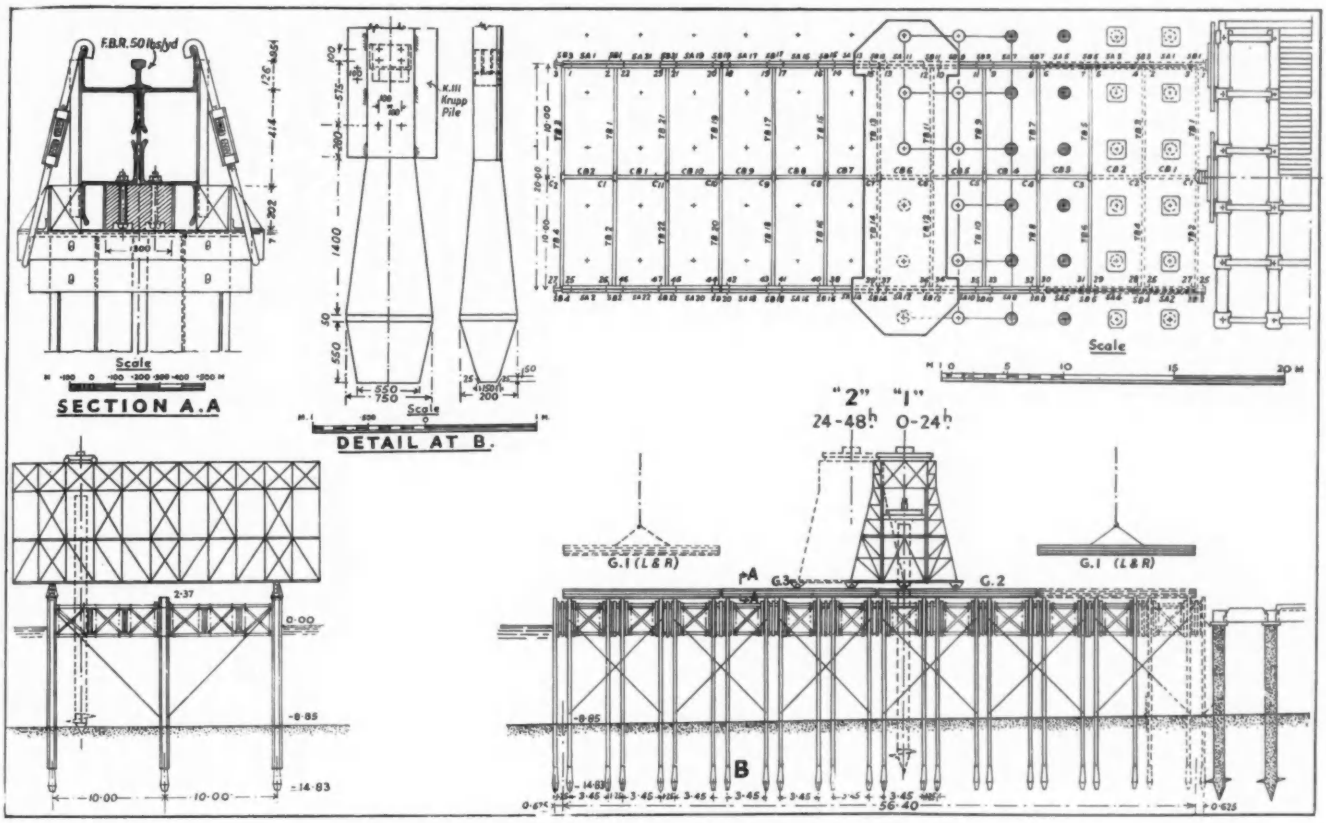



Fig. 2. Plan and elevations of gantry with details at A—A and B.

of 520 tons. The jetty to be built with one track on the approach and four on the head, with provision for a second approach track later. The surface was also to be suitable for road access.

(d) A landing stage for ferry boats giving not less than 10-ft. of water and a small boat loading stage.

(e) Permanent offices, transit sheds and sidings.

(f) Complete calculation sheets and design drawings to be submitted to and approved by the Turkish Authorities.

The jetty as finally built is shown on Fig. 1 and comprised:

A sand-filled section 116m. long giving a road width of 20m.

A concrete approach section 210m. long x 12.50m. wide increased to 18.0m. for the last 35m. by a low-level landing stage and access steps on each side, all on 19-in. diameter cylinders.

A transition section 37.60m. long on 42-in. diameter cylinders.

A head section 184.8m. long x 48.0m. wide on 42-in. diameter cylinders.

The design was generally in accordance with Turkish specifications. In view of the conditions under which the jetty was built and the uncertain materials, working stresses in steel and concrete were taken as 40 kg/sq.cm. and 1200 kg/sq.cm. respectively.

Wind on the unloaded structure was 250 kg/sq.m. and loaded 150 kg/sq.m. Maximum wave height was 4.00m. with an impact angle of 45% to the jetty centre line.

The cylinders were designed as columns fixed at the cap and in the sea bed subjected to bending and reinforced accordingly.

The dead load of the deck including beams averaged 2.70 tons per sq. m. and the maximum unit pressure at the underside of the helix 4.0 kg per sq. cm.

### Shore Works

No particular problems were involved in the design of the marshalling yards, culverts and permanent port administration buildings the latter being to standard designs supplied by the Ministry of Public Works.

The transit sheds shown in Fig. 1 were 96.0m. long x 21.0m. wide. Floor level was 1.10m. above track level, to allow for ease of loading and unloading, and the roof structure supported on side walls 3.20m. high above floor level. These were built in concrete block masonry and capped by a reinforced concrete beam. The roof trusses and purlins were designed entirely in timber using bolts and fasteners made from scrap reinforcing rods. The roof covering was galvanised corrugated iron.

In view of the hard nature of the foreshore, the uncertainty of what might be beneath it, and the need to arrange ferry and small boat landings with the consequent extra approach width, it was decided to use sand embankment for the first 116m. of the approach with adequate protection against wave action as indicated in the cross section A.A. Fig. 1.

The sand was retained between two mounds built with quarry rocks of from 100 to 500 kg. each with the seaward toe retained against timber sheet piling projecting 1.20m. above the sea bed. The seaward faces of these mounds were further protected by similar rocks but weighing from 1,500 to 2,000 kg. each

At some 75.0m. from the shore the 20 metre wide roadway split into two sections one 12.50m. wide continued on to the concrete approach at level +2.85m. and the other sloped down to ferry boat landing stage at level +1.75m. and that for small boats at +0.50m. The berthing faces of both these stages were formed by Krupp III sheet piling with a concrete capping beam and timber fenders backfilled with sand. The ferry boat stage overlapped the piled approach by 15.0m. so that the inside face was also sheet piled.

### Foundations

As already mentioned the borings indicated that the depth of silt and mud overlying the sand increased with the distance from the shore. For this type of subsoil, and in view of the heavy vertical and horizontal loads, a jetty carried on screwcrete cylinders founded in the silt was considered to be the best solution. The necessary plant was all available and as the concrete is poured within a watertight casing, as described later, the cylinders could be

## *Port of Iskenderun—continued*

Fig. 3. View showing deck erection on the concrete approach.

loaded shortly after driving if military necessity required. The completion of the deck structure could follow very closely on the driving of the cylinders thus giving a continuous increase in the available berthing space as construction proceeded, a very important advantage under emergency conditions.

With cylinders founded in silt considerable settlement must be expected although it was believed that the homogeneous nature of the subsoil would result in a settlement which would be uniform across the jetty but which would diminish from head to shore with the diminshing depth of silt. In consequence lateral beams were designed as continuous (over 9 spans in the head) and longitudinal as simply supported with some provision made for reverse bending moment over the cylinders.

The approach section 210.0m. long to a water depth of 7.0m. was founded on 320 screwcrete cylinders with shafts 19-in. dia. The bents spaced at 3.50m. centres longitudinally comprised 5 cylinders at 2.50m. centres with a helix 4-ft. dia. on the centre cylinder and 5-ft. dia. on the other four. The casings were made from 3 mm. sheet with corrugations spaced to suit the anticipated lateral pressure during screwing. The reinforcement was based on No. 8—$\frac{5}{8}$ dia. bars per cylinder increased at points of maximum moment, with stirrups at from 15 to 25 cm. centres.

The head and transition sections were founded on 416 cylinders 42-in. in diameter with 8-ft. diameter helices. The bents were spaced at 4.70m. longitudinally and comprised 10 cylinders at 5.0m. centres in the head reduced to 6 at the same spacing at the junction between transition section and approach. The casing was of 3 mm. sheet with corrugations and basic reinforcement of No. 16—1-in. diameter bars per cylinder and stirrups at 15 to 25 cm. centres.

Cast iron helices were used throughout, the thin casing being attached by welding to a $\frac{3}{8}$-in. thick steel strap studded to the upper rim of the helix casting. On the smaller diameter helices, the point formed part of the casting but for the large diameter reinforced concrete points 1.50m. long were cast on site.

To ensure adequate bond between the concrete filling of the helix and the concrete in the shaft a special reinforcement cage 40cm. diameter x 1.50m. long was cast in at the same time as the point so as to overlap with the main reinforcement.

Calculations and experiment indicated that for the jetty head cylinders a penetration of about 12 metres would give adequate bearing and resistance to lateral load. During the actual driving it was found that the torque required to rotate the cylinders reached an almost constant value at between 12 and 15m. penetration and this was taken as the criterion at which to cease driving. On the approach the penetration was reduced the screwing being stopped just above the surface of the sand layer.

### Deck Structure

In designing the deck structure, three main considerations had to be borne in mind. First that both shuttering and concreting afloat must be reduced to a minimum, secondly the lifts must be within the capacity of the available cranes and third that the deck must be useable as soon as possible and allow of easy rearrangement of railway tracks at any time.

The first need was met by the use of precast elements with cast in situ joints. The main beams met on the pile caps which being about 1.00m. square for the 19-in. cylinders and 1.50m. square for the 42-in., gave ample working space. The deck beams which were 50 cm. wide x 35 cm. deep and rhomboidal in shape were laid longitudinally side by side and the ends jointed over the main beams with cast in situ concrete.

All precast beams had to weigh less than 10 tons, the maximum erection crane capacity available. Some of the heavier beams were precast to only part of their depth with stirrups projecting and the remaining reinforcement and concrete added after placing in position on the jetty. This applied especially to the fender beams

By using precast units traffic could be handled direct over the deck beams even without the cast in situ concrete. To complete the deck a layer of rough concrete 5 cm thick was poured to seal the joints in the bearers, being finished to a 1% fall to the central drain holes and waterproofed with a layer of asphalt. On to this was placed a layer of sand 45 cm. thick followed by stone sets and surfaced with a 12 cm layer of ballast sprayed with tar at 7kg/sq.m. This type of construction absorbed the impact effect of the rail and road traffic and permitted rearrangement of rail and crane tracks up to the time when the macadam surface was complete. Even after this, alterations were not difficult.

On each side of the approach a conduit 60 cm. x 45 cm. deep with a removable cover was formed as can be seen from the cross-sections in Fig. 1. In one were laid the electrical services and in the other oil and water pipes.

Special bollards were designed in cast iron and cast locally, 26 in the head for a pull of 100 tons and 18 on the approach for 20 tons. Mooring rings were also provided. It will be noted that these mooring arrangements were provided along the full length of the approach to permit its use for berthing small ships. Precast concrete light posts were designed and manufactured at site. They were designed to carry two lights each with the bulb 6.50m. above deck level in the approaches and 10.0m. on the head.

The fenders provided throughout the length of the approach and head were of timber but not of the continuous type. As shown in Fig. 1, the outer pile cap at each side was carried up to give a smooth face about 1.0m. wide and standing about 15 cm. proud of the line of the fender beam. Between these projections, three timbers 25 cm. x 25 cm. were bolted horizontally. At each end of these timbers were bolted pairs of vertical timbers 20 cm. x 20 cm. x 2.10 cm. long. These formed the actual contact fenders and could easily be replaced when worn.

The deck was constructed in sections; about 21.0m. long on the approach and 32.0m. long on the head, with suitably formed expansion joints.

The flexibility of the structure supported on large diameter vertical cylinders was such that a system of fender piles was not considered necessary.

### MATERIALS

The quantities of material in the permanent structure were approximately as follows:

| | |
|---|---|
| Reinforced concrete in deck and cylinders ... | 17,000m$^3$ |
| Mass concrete ... ... ... ... ... ... | 925m$^3$ |
| Steel in casings, sheet piling and reinforcement | 2,900 tons |
| Earth and rock fill ... ... ... ... ... | 21,500m$^3$ |

## *Port of Iskenderun—continued*

| | |
|---|---|
| Surface area ... ... ... ... ... | 15,000m² |
| Cast iron helices and bollards ... ... ... | 1,700 tons |

Sand and ballast were obtained from a river bed to the north of the jetty and transported by sea and by road and rail.

Stone for the embankment and for concrete aggregate was brought in by road and rail from local quarries, the stone for aggregate being crushed on site.

Reinforcing bars and casing sheets were partly supplied from stocks in Turkey or from the Karabuk steelworks and partly from overseas. The former reached the site by rail and the latter was usually loaded from incoming ships into lighters for transport to the temporary site jetties. Much of the steel casing sheet was of poor quality and the reinforcing rods often arrived in a tangled mass requiring much time and labour to sort and straighten.

Practically the whole of the cast iron work was poured in a foundry in Haifa and shipped to site by small coasting schooners. It is a tribute to the skill and ingenuity of the Haifa foundry that they successfully supplied such a large quantity of material under war conditions in accordance with a tight delivery programme.

Timber was largely supplied from Turkey but some did come in from elsewhere. Cement posed a difficult problem in that it was obtained from a number of different places and frequently arrived damaged due to damp, long storage or other causes. To put some check on its quality a small testing machine was made at site.

For auxiliary plant and the innumerable other construction materials such as electrodes, wire, small tools etc. all available sources in Turkey, Egypt, Syria and elsewhere were tapped and there was little delay due to lack of supplies.

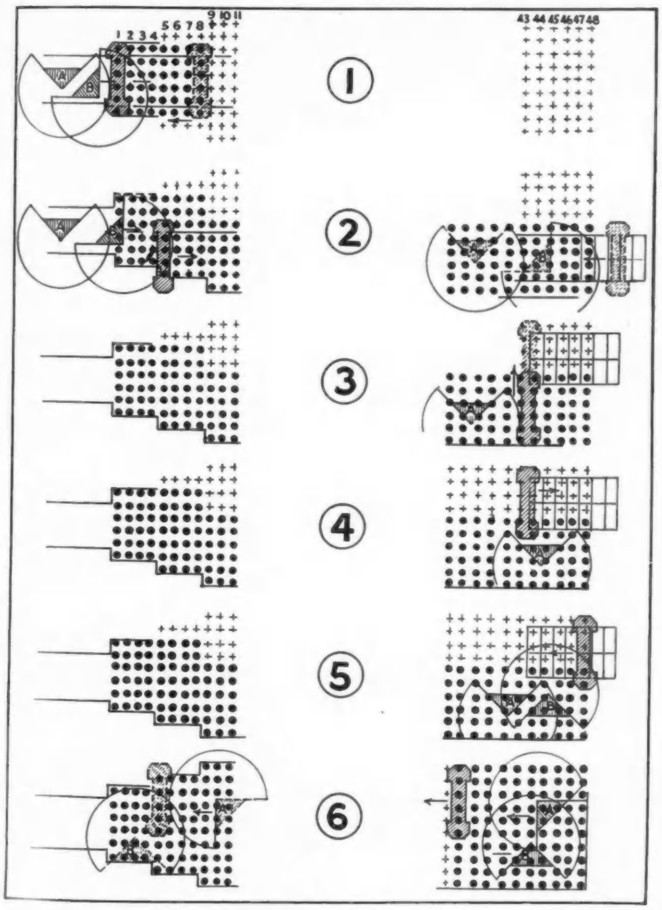



Fig. 4. Diagram showing operation of Gantry and Cranes A and B. The circles indicate cylinders driven and the crosses the location of cylinders still to be driven. The sequence of working was as follows: (1) Gantry erected driving cylinders on lines 1 to 8; (2) Gantry returned to line 5, skidded sideways and moved forward to drive cylinders to line 48 and run over to allow of deck erection; (3) Gantry returned to line 43 and staging prepared for skidding. Crane B dismantled; (4) Gantry skidded with outer wheels on staging and inner wheels on deck; (5) Gantry moves back driving cylinders in rows 48 to 43; (6) Gantry proceeds with completion of driving remaining head cylinders. Gantry and Crane B finally dismantled by Crane A.

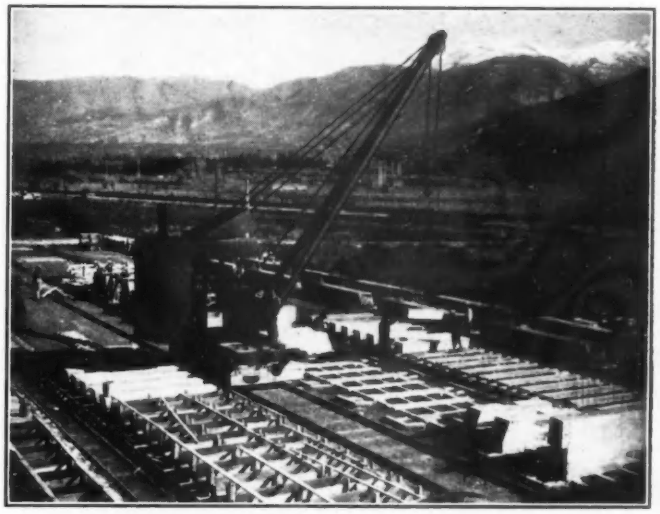


Fig. 5. View of precasting yard showing 5-ton loco crane.

### CONSTRUCTION

**General**

The temporary buildings for offices, workshops, stores and cement shed were arranged between the coast road and the line of the new siding between Ak Cay and the jetty, partly on reclaimed land. Some staff houses were built in the same area but most of the workmen's dwellings were put up to the North of Ak Cay.

A space near the jetty was reserved for the precasting yard and for the storage of helices, casings and other material.

All Braithwaite's heavy cranes had been D.C. operated in Karabuk and they were able to transfer the power plant from that contract to Iskenderun. Sufficient power was available from this to operate the screwing and casing plant with the help of individual sets for use in special areas such as the jetty head and the floating plant. The 10-ton cranes and the percussion pile drivers were steam-operated. It required a great deal of hard work and ingenuity to keep all this plant working as spares were often unobtainable.

The staffing of the contract presented a number of difficulties but these were gradually overcome. Braithwaite's experienced staff in Turkey when the contract was let was about 10 engineers and foremen which was later augmented from their organisations in India and Egypt as transport permitted. However great reliance had to be placed on staff recruited in Turkey some of whom were skilled as engineers and foremen and rapidly acquired the specialised knowledge needed for this type of construction.

Two temporary jetties were constructed to handle material from lighters, one at the precast yard and the other the workshops handling general material.

**Screwcrete Cylinders**

The casing was manufactured from 3 mm. thick sheet sent to the site in flat sheets usually about 1.00m. x 2.00m. These were sheared to size, curved and welded into strakes generally 1.00m. long. Strakes are usually made longer but suitable sheets were not at the time obtainable. For the 42-in. cylinders two sheets were welded together to form the full circumference. These strakes were beaded, the ends belled using special hydraulically operated machines and assembled to make up sections of casing 5.0m. long.

The longitudinal welding was done partly by hand and partly by automatic machine, the circumferential entirely by hand.

## *Port of Iskenderun—continued*

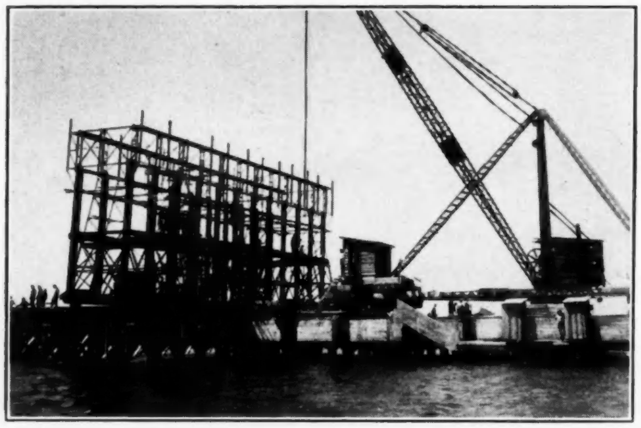


Fig. 6. General view of gantry in course of erection.

Reinforcing bars for the cylinders were assembled in jigs and welded to the stirrups thus forming a rigid cage some 6m. long which could be lowered into the cylinders by the cranes on the screwing machine.

For the actual driving operation a section of casing (or more than one in deep water) was welded to the steel band on the helix and the steel screwing mandrel placed in position. For the 42-in. cylinders, the mandrel was a 3-ft. outside diameter cylinder bolted to the helix, for the 19-in. an 8-in. diameter bar or an 11-in. outside diameter tube which had a special spigot end to suit a socket in the helix. The cylinder was then suspended vertically from the screwing machine and lowered on to the sea bed being maintained in position by the penetration of the long point. The screwing device was then connected to the mandrel and driving commenced, being stopped from time to time to bolt on additional lengths of mandrel or weld on sections of casing. The complete operation from pitching to placing reinforcement took about four hours with the small cylinders and twelve with the large

For the 19-in cylinders it was decided to use a standard screwing machine mounted on barges Two barges 60-ft long x 15-ft. wide were braced together leaving a space of 3-ft. between them thus forming a platform 60-ft. x 33-ft. on which the screwing machine was mounted in the centre of the long side allowing the cylinders to be assembled over the side. A guide was arranged just above water level which with the further restraint at machinery platform level 16-ft. above, provided the guiding necessary to ensure that the cylinders were accurately placed, and driven.

The generating set, mounted on the rear barge, supplied the power necessary to actuate the screwing motors, winches, welding set and dewatering pump. The latter had to be provided as water sometimes entered the cylinders due to waves splashing over the top or to slight casing leaks, although in spite of the poor quality of much of the casing sheet, very little trouble was experienced from this cause.

During the early stages the concreting plant was also located on the floating screwing barge but subsequently this was arranged on a separate float. All materials were brought out by small lighters.

Concrete in the cylinders to 10-ft. below bed level was vibrated using poker vibrators.

A tug was always available to tow the floating plant into the shelter of the old harbour in case of bad weather.

For driving the 42-in. dia. cylinders in the jetty head it was thought that floating plant would be rather unstable and a risky situation might result if a sudden storm arose just as a cylinder was started. It was decided, therefore to construct a special gantry capable of handling 6 cylinders and running on tracks supported on piles driven into the sea bed.

The gantry shown in Figs. 2 and 6 was constructed in the site workshop from pieces of other plant and steel obtained locally. The actual screwing was done by means of a Braithwaite capstan running in vertical guides and handled by an overhead gantry crane which formed part of the gantry. While screwing was in operation in one set of guides, the crane proceeded with the assembly and pitching of cylinders in one or other of the five other guides. The capstan and mandrels were transferred to the next cylinder as the preceding one was completed.

The construction of the staging presented a difficult problem in that conventional material for rail girders was not available and the sea bed was too soft to permit the use of precast piles which would have to be too long and heavy to be driven and withdrawn with any available plant.

It was finally decided that the whole structure would have to be made from sheet pile sections using timber for bracing purposes. The rail girder section was made of Krupps K.III sections welded together as shown in Fig. 2. The piles were made up in box section as shown in the same illustration with the specially-designed concrete foot shown. A 2-in. diameter hole ran down the centre of the foot which would be used for jetting in case of need. They were never actually used, the lifting appliances available being adequate.

The piles were firmly braced together in two directions by standard prefabricated bays of bracing about 2.75 cm. x 3.00 cm. constructed of timber with steel tie rods. These were attached to the piles by clamps for ease of removal.

While awaiting concreting and the placing of the superstructure, all cylinders were held in position by horizontal bracing made from pipes with a screw adjustment for length, arranged just above water level.

The two Scotch derrick cranes which were mounted on the deck for the erection of the superstructure were used for the erection of the gantry, to assist in feeding material to it and for erecting and dismantling parts of the staging.

The 42-in. cylinders were concreted partly from floating plant and partly from a special concreting platform following the gantry on the same staging.

The shuttering for the cylinder caps which was fabricated on shore was supported on timbers bolted outside the casing and the concrete was poured from a mixer supported on a floating platform.

### Deck

The precasting of deck units was carried out on an area 187m. x 39m. at the shore end of the jetty which had been largely reclaimed from the marsh by tipping earth fill.

The yard ran North and South parallel to the shore with the reinforcement fabricating area and local cement stores to the North

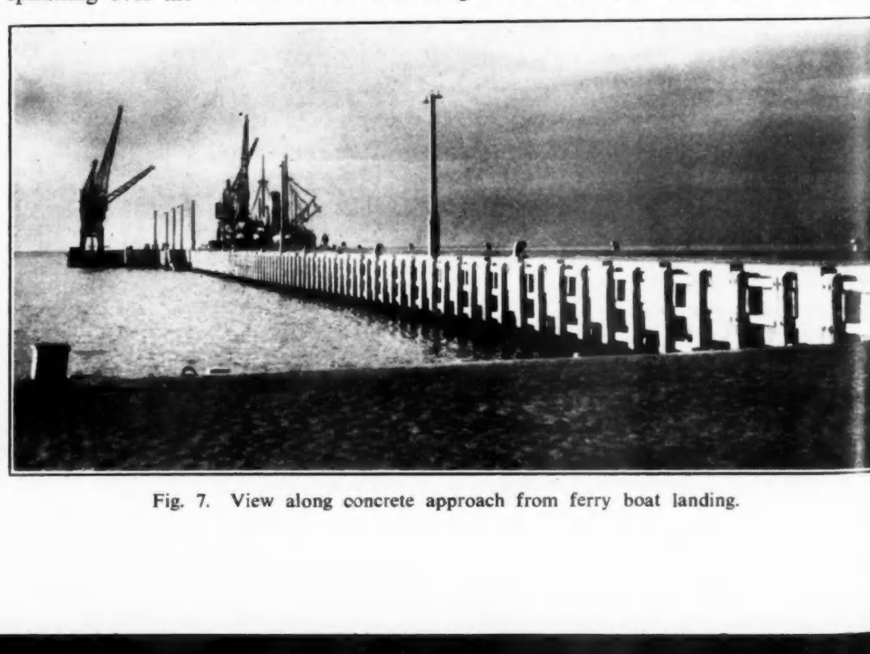


Fig. 7. View along concrete approach from ferry boat landing.

## Port of Iskenderun—*continued*

Fig. 8. General view of completed jetty showing rail approach tracks and quayside cranes.

and concreting plant about halfway along the west side as shown in Fig. 1. A section of the yard is shown in Fig. 5.

Sand and gravel were brought in largely on Decauville tracks from the temporary jetties and washed in two installations one on each side of the mixer. Cement was brought on a 3-ft. 6-in. gauge track from the main storage sheds near the marshalling yards. Cement brought in by sea was, whenever possible, stored at the small sheds to the North of the yard.

Concrete from the mixer was transported to the forms in skips mounted on Decauville tracks. One track ran out from the mixer with turntables connecting to the four main North-South distribution tracks from which the skips were unloaded and tipped by means of a 5-ton steam locomotive crane running on a standard gauge track down the centre of the yard. For beam forms beyond the range of this crane auxiliary chutes were used.

The beam casting was done in four separate sections. Two of these lay either side of the 5-ton crane track and were used for beams of up to about 3 tons in weight which could be handled by that crane. A third on the East side of the yard was for heavier beams up to 9 tons which required separate handling arrangements although the placing of concrete would be done by the 5-ton crane. For lifting these beams on Decauville tracks for transport to the stacking area, two hand-operated Goliath cranes each spanning 5.56m. were made at site. The fourth section was under the 15-ton S.D. crane at the end of the jetty where some of the heavier beams were cast and all of them stored.

Transport from yard to jetty was by flat trucks running on extensions to the Decauville tracks or on the broad gauge track as laid on the jetty. This latter was only brought into use for feeding material over the approach to the head.

To economise in shuttering the casting areas were provided with concrete floors which when protected with grease paper, were used as bottom shuttering. Side shuttering was used only on alternative beams, the intermediate ones being poured against the sides of the others after stripping and greasing.

For the erection of the beams on the pile caps, a 10-ton Scotch derrick crane was erected on rails on the approach embankment and moved forward erecting the deck of the concrete approach as illustrated (Fig. 3). The crane had a jib 120-ft. long and was able to place an 8-ton beam some 60-ft. ahead.

The precast main beams were placed first and the joints concreted. On these were placed the road beams on which the crane moved forward leaving the joints to be concreted later. This crane is marked A on Fig 4. On reaching the end of the concrete approach it erected a second 10-ton S.D. crane marked B which assisted with the erection of the gantry staging and erected the gantry itself.

The various movements of the gantry required to complete the driving of all the 42-in. cylinders is shown on Fig. 4 together with the rearrangements of the crane necessary for the erection of the deck and quay cranes.

It will be noticed that the gantry wheels were so arranged that two cylinders were driven from cantilevers and four from between the rails, thus effecting an economy in the steel required for the gantry.

The procedure for skidding the gantry laterally was as follows:

Staging was erected on the line of the new longitudinal path of the gantry with rail girders in position. At the point where lateral skidding would take place additional piles were driven to support two lateral girders and rails placed over the longitudinal ones. The gantry was then rolled forward to the skidding position, jacked up and two rail girders placed underneath to line up with those already in position. Skid carriages were then placed under the gantry which was lowered on to them and skidded sideways to the new position by means of winches. Here it was again jacked up and after the removal of the carriages and lateral girders, lowered on the longitudinal girders in the new position.

Once the deck beams were in position and concreted the other operations required for completion followed a normal course.

The jetty was completed and handed over at the end of 1944, although ships had been able to tie up and unload using their own derricks by the middle of that year. Views of the completed work are given in Figs. 7 and 8.

# International Congress on Ports and Inland Waterways

Reference was made in our issue of April, 1956, to the 19th Congress of the Permanent International Association of Navigation Congresses which is to be held in London from July 8 to 16 this year. Considerable progress has been made with the arrangements and fuller details can now be announced.

In pursuance of the aims of the Association which are to promote the international exchange of information about the construction, equipment and operation of ports and waterways, over 100 papers will be presented on 11 subjects covering a wide range of interests These papers are listed below. The work of the Congress is divided into two Sections—Inland Navigation (Chairman: Mr. C. M. Marsh, Divisional Manager, North Western Division of British Transport Waterways) and Ocean Navigation (Chairman: Mr. G. A. Wilson, Chief Engineer, Port of London Authority).

Special efforts are being made by the British Organising Committee, under the Chairmanship of Sir Arthur Whitaker, President of the Institution of Civil Engineers, to ensure that the Congress will be as successful and as valuable as preceding Congresses, particularly those held in Lisbon and Rome in 1949 and 1953 respectively. The periodic nature of the Congresses ensures that all the delegates may have the opportunity of introducing or hearing about and discussing developments in maritime and inland waterway design which have taken place within the period, also in dock and harbour construction, port operation and cargo handling equipment and practice. The Congress will bring to this country the leading figures in these fields from all parts of the world and will provide an opportunity for them to learn what Great Britain has to offer.

**Extensive Foreign Representation.**

Over 800 delegates, including many eminent port and inland waterway engineers and operators, have signified their intention to participate in the Congress. Among the countries to be represented are practically all European countries, including substantial delegations from Poland and Yugoslavia, and countries as far afield as Australia, Viet-Nam and Japan. Particular interest has been aroused by the fact that papers are to be presented by the U.S.S.R.

## International Congress on Ports and Inland Waterways—continued

although it is not yet known if any Russian delegates propose to attend.

Besides participation in the technical discussions, which will be held at the Institution of Civil Engineers, opportunity is being given in the programme of the Congress for delegates to study port working in this country and visits are being arranged to London and Southampton docks, South Wales ports, Manchester and Liverpool, Hull and Newcastle, Scottish ports, various inland navigations and Bristol. These visits will enable delegates to meet and to exchange views with operators and manufacturers of port equipment.

**Official Receptions and Social Activities.**

Some of the more interesting features of the Congress activities in London include the opening ceremony which will be held in the presence of the Duke of Edinburgh at 3 p.m. on Monday, 8th July. On that evening there will be a reception given at the Tate Gallery by the Minister of Transport and Civil Aviation. On the evening of Wednesday, 10th July, there will be a reception given at Hurlingham by Viscount Waverley, Chairman of the Port of London Authority. The social activities of the Congress in London will conclude with a dinner at Grosvenor House on Monday, 15th July. On the following day the delegates will leave for three or four-day excursions to various parts of the country.

The British Organising Committee has been very gratified by the response to an appeal for funds to meet the expenses of the Congress. Among those contributing have been port authorities, shipping companies, consulting engineers, civil engineering contractors, industrial corporations, oil companies and manufacturers of port equipment. There is still, however, a considerable distance to go before the Congress is assured of sufficient funds but the Committee is confident that both the technical interest of the Congress and the opportunity so offered to show the world what Britain has to offer in the field of maritime engineering and operation merit and will attract further support.

Further information about the Congress will be gladly supplied by Mr. A. C. Morrison, Secretary of the British Organising Committee, P.I.A.N.C., at the Ministry of Transport and Civil Aviation, Berkeley Square House, London, W.1.

Participation in the Congress is limited to members of the Association. Information about membership may be obtained from the Secretary, British Section, P.I.A.N.C., at the Institution of Civil Engineers, Great George Street, London, S.W.1.

The subjects of the papers are as follows:—

**Section I—Inland Navigation**

Question 1.—The role of inland waterway transport and its relation to other modes of transport with a view to furthering the economic development of the various countries. Reporter-General—M. J. Blockmans, Administrateur-Inspecteur Général des Services Maritimes d'Anvers. Papers from Canada, France, Great Britain, Italy, Netherlands, Pakistan, Sweden, Switzerland, U.S.A., U.S.S.R., Western Germany, Yugoslavia. The British author is Mr. C. A. Wilson, M.I.C.E.

Question 2.—Evolution of types of propulsion and control of single craft and trains of barges on rivers and canals. Comparison between self-propelled vessels and others. Reporter-General—Major-General Gerald E. Galloway, Corps of Engineers, U.S. Army. Papers from Belgian Congo, Belgium, France, Italy, Netherlands, U.S.A., U.S.S.R., Western Germany.

Question 3.—New means of utilising the hydraulic energy of navigable waterways. Their interference with navigation and their influence on the design and construction of all structures concerned, with special regard to movable barrages (high dams). Reporter-General—Mr. R. D. Gwyther, C.B.E., M.C., M.Sc., M.I.C.E. Papers from Austria, Czechoslovakia, France, Italy, Netherlands, U.S.A., U.S.S.R., Western Germany.

Communication 1.—Means of dealing with large differences in head in order to facilitate the passage of vessels on inland waterways. Comparison of the various solutions from the technical and economic points of view. Works constructed and contemplated. Results obtained. Reporter-General—Mr. C. A. Wilson, M.I.C.E. Papers from Austria, Czechoslovakia, France, Spain, U.S.A., Western Germany.

Communication 2.—Means of making watertight the beds and dykes of navigable canals and rivers. Reporter-General—Mr. J. T. Evans, O.B.E., B.Sc., M.I.C.E. Papers from Belgium, France, Great Britain, Italy, Netherlands, Poland, U.S.A., Western Germany. The British paper is being contributed jointly by Mr. C. H. Dobbie, B.Sc., M.I.C.E., F.G.S., M.I.W.E., M.Cons.E. and Mr. E. J. R. Kennerell, B.Sc., A.M.I.C.E.

Communication 3.—(common to both sections). Influence of ice on navigable waterways and on sea and inland ports. Means of overcoming its effects. Reporter-General—ir. J. Volkers, Chief Engineer Director of the Rotterdam Seaway. Papers from Austria, Belgium, France, Italy, Netherlands, Poland, Sweden, U.S.A., U.S.S.R., Western Germany.

**Section II—Ocean Navigation**

Question 1.—Measures to be taken for improving the handling of general cargo between the vessel and the storage installations on the quay or between the vessel and the means of inland transport and vice versa. Reporter-General—Mr. F. H. Cave. Papers from France, Great Britain, Italy, Japan, Mozambique, Spain, Sweden, U.S.A., U.S.S.R., Western Germany. The British author is Mr. N. A. Matheson, M.I.C.E., M.I.Mech.E.

Question 2.—Berthage for large oil tankers. Handling of their cargoes. Pipeline layout and hose-handling equipment for loading and discharging tankers. Provision of facilities for distribution by road, rail or smaller vessels. Measures to be taken for ensuring safety. Methods of preventing or reducing pollution of harbour waters. Equipment for gas-freeing and the cleaning of tanks of oil-carrying vessels. Reporter-General—Mr. C. W. N. McGowan, M.A., M.I.C.E., M.I.Mech.E. Papers from Denmark, France, Great Britain, Italy, Netherlands, Spain, Sweden, U.S.A., Western Germany. The British author is Mr. E. J. Sturgess, B.Sc., A.C.G.I., F.Inst.Pet.

Communication 1.—Origin and effects of long period waves in ports. Precautions to be taken for the safety of vessels. Possibilities of minimising the effects. Experiments using scale models. Reporter-General—Professor J. Allen, D.Sc., F.R.S.E., M.I.C.E. Papers from France, Great Britain, India, Italy, Japan, Netherlands, Portugal, Union of South Africa, U.S.A., Western Germany. The British author is Mr. R. C. H. Russell, M.A., A.M.I.C.E., A.M.I.Mech.E.

Communication 2. — Maritime locks and graving docks (dry docks). Calculations and modern methods of construction. Types of gates and caissons. Stresses to which they are subject. Designs adopted, specially for those which are exposed to swell. Reporter-General—Mr. J. H. Jellett, O.B.E., M.A., M.I.C.E. Papers from Denmark, France, Great Britain, Italy, Japan, Netherlands, U.S.A., U.S.S.R., Western Germany. The British paper is being contributed jointly by Mr. D. C. Milne, B.Sc., M.I.C.E., Mr. T. F. Burns, M.I.C.E., M.I.Struct.E., and Mr. P. F. Stott, M.A., A.M.I.C.E.

Communication 3.—Siltation in coastal waters, in estuaries, in channels, in tidal basins, in enclosed docks and in maritime canals. Measures for minimising it. Modern methods of measurement of depths, currents, waves, tides and silt movement in coastal waters and in estuaries. Reporter-General—Mr. C. H. Dobbie, B.Sc., M.I.C.E., F.G.S., M.I.W.E., M.Cons.E. Papers from Belgium, Czechoslovakia, France, Great Britain, India, Italy, Japan, Mozambique, Netherlands, Poland. Spain, U.S.A., U.S.S.R., Western Germany. The British paper is being contributed jointly by Mr. G. A. Wilson, M.Eng., M.I.C.E., M.I.Mech.E., Mr. N. D. E. Stephens, B.Sc., A.M.I.C.E., and Mr. F. H. Allen, M.A., M.A.I., A.M.I.C.E.

A distinction is drawn between Questions and Communications in that the latter are intended to increase the existing documentation on a specified subject and do not call for the drawing up of conclusions.

**Improvements at Port of Pondicherry.**

A project estimated to cost £225,000 and designed to stimulate trade through the port of Pondicherry, on the Coromandel Coast, has recently been inaugurated. The work includes the construction of a reinforced concrete pier 1,200-ft. long equipped with six cranes, railway sidings and transit sheds. The port is being developed in order to relieve some of the congestion at present being experienced at Madras.

# Problem of Economical Timber Handling

## Suggestions arising from the Manchester Conference

By A. GOURVITCH

The Timber Handling Conference at Manchester, held under the auspices of the Timber Trade Federation of the United Kingdom, at the end of September, 1956, was an event which created wide interest throughout the industry. Three hundred delegates, both from this country and abroad, assembled in Manchester to discuss technical papers presented by some of the most prominent members of the Timber Trade in the U.K. The speakers dealt with the methods of timber handling adopted and developed by them in their own yards, and participated in the very interesting discussions which ensued. The delegates also visited the docks of the Manchester Ship Canal Company and witnessed demonstrations of various types of mechanical handling equipment for timber. It was the first time that representatives of all leading timber ports in this country attended such a Conference and showed their interest in the British Timber Trade, and only the second time in the history of the Trade that handling of timber was the focal point of a Conference.

The meetings were conducted in a businesslike manner and little time was wasted on generalities and the discussion of unimportant details. All participants had one thing in common—they realised that timber handling was a problem they were facing every day of their lives; they came to learn and share their experience, and there is little doubt that no one left the Conference without having acquired some valuable knowledge.

It has been arranged to publish some of the papers which were read at the Conference in forthcoming issues of "The Dock and Harbour Authority" so, as an introduction to the series, I propose to concentrate on a few questions which arose in the course of the discussions, both official and private, and which the different speakers had only posed, without attempting to find the answers.

The most important impression I carried away was the realisation that so little was known about proper methods of handling when applied to timber. Discussions on Time and Motion Study, Work Study, Stop-Watch Observation and experiments in different handling methods, indicated that we are without doubt badly behind the times. Timber has been handled manually for hundreds of years, yet no one has, apparently, given sufficient detailed thought to the individual operations to have an opinion as to the best and—in terms of manual energy — most economical way for instance of delivering timber manually from a pile to a lorry. Tradition prescribes that the deal porter should pick up a piece on his shoulder, walk a few steps, turn 90° and place the piece on the lorry. One lecturer suggested that the lorry should be backed with the tail against the pile and the wood delivered to the lorry without turning the piece through 90°. This may be an improvement, but it still appears to me that it is wrong to move wood lengthwise for a distance of anything from 10-ft. to 20-ft.

If—whatever the tool used in piling away—piles were placed sideways against the road, not endwise, pieces could be levered or turned sideways only 1 or 2-ft. to be placed on the vehicle. This would reduce five or tenfold the energy required to deliver timber manually to a lorry; it would also avoid the need of the very wide roads required to enable lorries to get to a pile endwise, across the roadway. It would, however, create the problem of how to cope —piling and redeliverying—with the second, third and fourth piles if they are different from the first, as they are likely to be in the majority of cases. Or should one—economical—method be adopted for delivery of bulk piles and the traditional method be retained for small parcels?

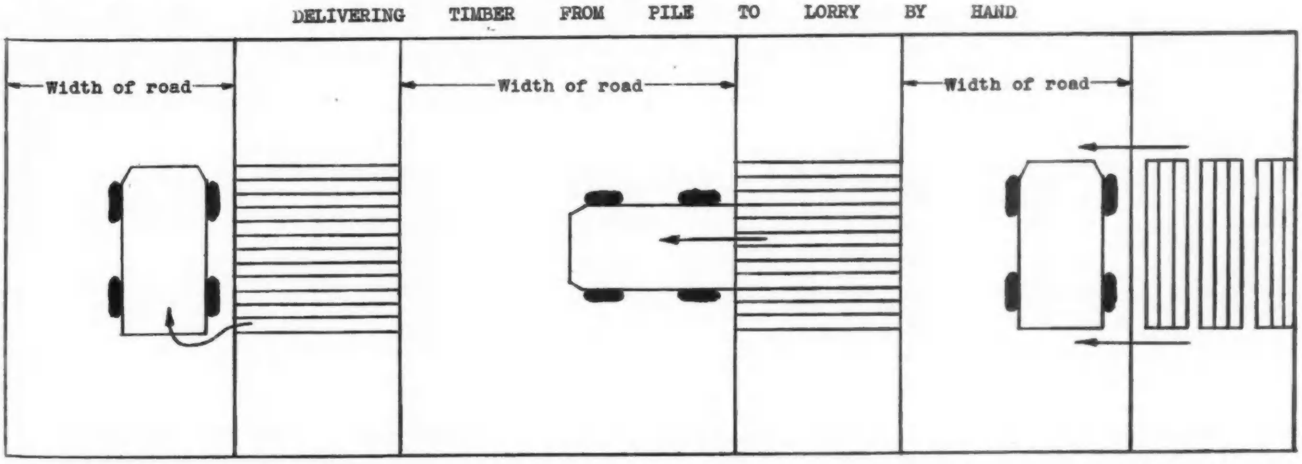
This again leads to the question of mechanical equipment. Through the courtesy of the Manchester Ship Canal Company, we were afforded a unique opportunity of seeing the latest cranes, forklift trucks, straddle carriers, etc. in action on timber. It was a most impressive demonstration. What depressed many spectators, however, was the obvious fact that hardly any of the equipment shown was specially designed for, or even adapted to, timber handling.

In my view, the front lifting forklift truck is wrong in conception for a long and bulky commodity like timber. It is, of course, ideal for short packages such as plywood and wallboard and, possibly, hardwood, but it does not seem right to carry a piece of timber, say, 20-ft. long across a carriage which is only 4 or 6-ft. wide. I am not qualified to discuss side-loading forklift trucks or swivelling forklift trucks as I have not seen enough of their work, and regretably, I was not impressed by the demonstrations. (Straddle Carriers do not come into this context, as they are carriers and not piling lifters.)

Why is the Timber Trade veering away from cranes? The answer was given during a discussion; unfortunately, none of the crane manufacturers seemed prepared to deal with the problem. Slings are a poor tool to work with as they often damage the wood and break up the set. Also, men are required to put the slings round sets, hook on to cranes, hook off, and then take the slings off. The main attraction of the forklift truck operation lies in the fact that the driver on his truck is a self-contained unit — as the Straddle Carrier driver is—whereas the crane driver requires one or two slingsmen for his operation. When will an enterprising crane manufacturer design and develop a contraption which can be safely operated from the crane cabin to secure the set and to put it away without assistance from slingsmen?

One equipment manufacturer has brought out crane forks of a very ingenious design which were not demonstrated at Manchester. For small packets, it appears to be an ideal tool; when, however, the forks are designed to cope with a set of timber 3-ft. 6-in. wide

DELIVERING TIMBER FROM PILE TO LORRY BY HAND




(1) The traditional way (2) Tail-on lorry backed against traditional end-on pile obviates turning the timber through 90° but requires wider roads (3) Is this the way of the future ?

## *Problem of Economical Timber Handling—continued*

and 3-ft. 6-in. high, and weighing two tons or thereabouts, the fork becomes so bulky and heavy that it can hardly be manœuvred by a man standing not very firmly on a timber pile or on a lorry. In my opinion, the answer to the sling problem must be something that drops from above and locks the set securely from the driver's cabin. Such things do exist in Sweden and in the United States. Why are we, in this country, so old-fashioned in this respect? Surely crane manufacturers relying, as they do, on the timber trade for a fair proportion of their sales of cranes, should pay more attention to this problem.

Another interesting point came up: there were no conveyor manufacturers present, either at the Conference or the demonstration. Why is it that, in this country, conveyors are hardly ever used for timber handling? After the first World War, there was a large conveyor installation working in Grimsby and, between the wars on at least two London wharves, large conveyor installations were in use, one of them very successfully. Why have they gone out of fashion? We have, all of us, fallen for the idea of packaging timber, i.e., of making it up into sets, and lifting it with cranes or forklift trucks, etc. One of the papers described how one firm in London has used conveyors to great advantage in the piling operation. There may be a great deal more in conveyors, and some of the manufacturers would be well advised to pay attention to this problem. Personally, I think that for a number of operations "conveyorizing" timber may be a much better proposition than set-packaging it.

I should not like to leave the question of equipment seen at the demonstration without saying that as such the machines demonstrated were very impressive indeed. The advance in crane design, the development and variety of forklift trucks shown, the tractors and straddle carriers were most interesting to observe. The straddle carriers in particular impressed me as really excellent timber handling machines of great possibilities.

How is it that timber handling is still in its infancy? How is t that timber is being handled once, twice, three, four times, addi g expense and not increasing the value? How is it that the ba c problems of handling economically were not solved years ago, s they were in other industries? Why have we not made many mo e experiments? I suggest that the answer lies in the structure of t e timber trade, which in this country, consists of a large number of comparatively small firms; even the largest are not industrial gian s. No firm can, individually, find the facilities, the time and the mon y to carry out a full scale investigation—and nothing less will do. The biggest timber handlers are not members of the trade, they are some of the Dock and Harbour Authorities in this country. They have the facilities and, even more important, they have the experience of how to tackle such problems. These are problems which are common to most authorities and also to most members of the timber trade. The Timber Handling Conference showed clearly that the ports are vitally interested—could one hope that a joint effort may result?

I suggest that a working party, consisting of representatives of the leading timber Port Authorities and of the Timber Trade Federation, could very quickly draw up a list of urgent problems to be investigated ; that a judicious number of co-options from manufacturers, trade unions and consultants could produce answers to a large number of the problems within a short time, and that the best method of approach to any remaining questions could also be worked out in a reasonably short time.

Working parties, panels and committees may not be regarded with much favour these days, particularly by hardworking men who have more than enough to occupy their time already. Despite this, it is too much to hope that these prejudices may be cast aside, for once, to deal with a set of problems which are unlikely to be solved by individual efforts?

# Port Working at Colombo

## Report of Commission of Enquiry

The report of the Commission of Enquiry on the working of the commercial sector of the port of Colombo was published on January 21st last. The report, which was prepared by Mr. E. F. N. Gratiaen, is now being considered by the Government of Ceylon, and no indications have yet been given as to whether the various recommendations will be adopted. Their implementation would result in a great improvement in the efficiency of the port. The main recommendations are as follows:

(1) A port authority with some measure of autonomy should be established, but subject to certain safeguards so as to prevent the authority adhering to any general policy contrary to that of the Government.

(2) The port authority should be reorganised in order to undertake more effectively its function of directing, controlling, co-ordinating and supervising the work of private operators.

(3) That the services of an expert from abroad, possessing practical experience in dock management and port traffic organisation should be obtained for the purpose of advising the port authority on reorganisation.

(4) Special legislation should be introduced for the purpose of regulating industrial relations in the port and, in particular, providing for the expeditious and equitable settlement of trade disputes and prohibiting strikes or lock-outs.

(5) The hours of work, rates of pay, and other conditions of work (including the payment of incentive bonuses) should be revised after joint consultation between employers and labour representatives and after adjudication, if necessary, under the new machinery recommended by the Commissioner.

(6) The port authority should establish a welfare organisation so as to ensure better meals, canteens, rest rooms, housing, etc., for dock labourers.

(7) The number of private contractors operating in the port should be reduced, and their cargo handling operations should be directed, controlled, co-ordinated and supervised by the port authority.

(8) The system for tallying cargo for customs purposes should be expedited, and the procedure for collecting rent from consignees should be revised.

(9) The clearance of cargoes imported by the Government storekeeper and by the food commissioner should also be expedited.

(10) The police should be primarily responsible for preventing pilferage in the port.

**Two Fundamental Problems**

In his report the Commissioner states that in his opinion two fundamental problems require to be solved—the lamentable deterioration of the labour situation in the port at the present time and the lack of planned co-ordination of cargo handling operations at alongside quays and "in the stream."

Dealing with the labour problem he states that the work of the port during the past year has been paralysed on several occasions by strikes resulting from disputes which (whatever the merits may have been) could very easily have been settled by the normal machinery of negotiation or, if necessary, adjudication; the situation has been further aggravated by union rivalry and constant clashes between the personalities of union leaders competing with one another for supremacy.

On some occasions, union leaders had themselves found difficulty in persuading their ill-disciplined members to call off wild-cat strikes. Throughout the period of unrest, workers had progressively tended to defy even the reasonable orders of their employers. In some instances employers had submitted to demands which they genuinely believed to be unjustified—the reason being that they had been forced into submission through the influence of political pressure (actual or assumed).

The country could not afford to allow such state of affairs to continue any longer. Every docker was entitled to receive a decent

## Port Working at Colombo—*continued*

wage and to be assured of other satisfactory conditions of labour; he must realise at the same time that in return for these benefits his employer was entitled to claim an honest day's work.

After mentioning a number of ways in which conditions of work are unsatisfactory, including meals, transport and hours of work, the Commissioner recommended that a welfare office should immediately be established by the port authority to give welfare the full attention required and to take prompt action in these and similar directions.

As far as labour legislation for the port is concerned the Report states that until industrial relations can be improved permanently the major problem cannot effectively be solved. In the first place continuity of work must be assured as frequent dislocation of work by strikes or lock-outs does far more harm to the general community than it does to the immediate parties to a particular dispute. At the same time some new machinery must be devised which will guarantee a reasonable and expeditious settlement of disputes of all categories without interruption of essential work. It is recommended that special legislation should be introduced to provide for the settlement of disputes arising in the port of Colombo, as regards wages, conditions of work, and matters affecting discipline. The main features include the notification by the worker of the particular union to which he belongs, methods for dealing with disputes and rights of dismissal.

"The introduction of these special safeguards would obviate any justification for resorting to the weapon of strikes, go slow or lock-outs as a means of settlement of trade disputes in the port. I therefore recommend that an Act of Parliament, while introducing the protecting machinery . . . should at the same time expressly prohibit lock-outs or strikes in the port — the term 'strike' being defined so as to include a deliberate slowing down of work by concerted action. The prohibited acts, or their incitement, should be appropriately penalised, and the sanctions imposed should include, in the case of a private employer, the loss of his operating licence, or, in the case of the striker, cancellation of his registration as a dock labourer."

Continuing, the Report says that the Commissioner does not think that the port should be nationalised in the sense that all cargo handling now undertaken by private operators would be entrusted to a port authority functioning as a government department engaging its own labour and using its own equipment for the purpose. The introduction of this change under present conditions would only cause the existing state of affairs to deteriorate still further. The port authority lacks personnel possessing the necessary practical experience.

**Millbourn Report Ignored**

The adverse criticism of Sir Eric Millbourn and Mr. A. E. Christoffelsz in their report of September 16th, 1951, on the number of landing and wharfaging companies which operate within the port and on the conditions under which they operate, applies with equal force to the number of stevedoring contractors. It is regretted that little attention has been paid to the Millbourn Report during the past five years, and the Commissioner is convinced that if its recommendations on these and many other subjects had been implemented, much of the subsequent deterioration which he observed would not have arisen.

There are seven cargo and four coal stevedoring contracting firms operating at the present time. Each employs insufficient permanent labour and equipment to guarantee the efficient performance of its duties as and when they are undertaken. The deficiency of labour is now met not only from the small "pool" controlled by the port labour manager but also from casual labour. It was often observed that some contractors were recruiting casual labour while other contractors had competent permanent labour idling, because none of their ships were available for work at the time.

"It is essential that casual stevedore labour should be done away with altogether in the port. In addition, the port pool of stevedore labour has not worked well, consisting as it does of men who are also largely unqualified and have little loyalty to the immediate employers whom they intermittently serve. I have discussed this problem with represenetatives of all the stevedore contractors, and they have unanimously agreed to the following proposals:

(a) That they should combine their resources and their permanent labour, and form themselves into a single company undertaking all stevedoring operations under the general direction and control of the port authority.

(b) That the present port labour pool, which has virtually become a pool of stevedoring labourers, should be scrapped, and its members (subject only to any individuals being rejected, with the approval of the port authority, for proved inefficiency or unsuitability) absorbed in the permanent labour force of the new company.

(c) That as a condition of the licence to be issued to the new company, its permanent labour force and equipment should be sufficient in the opinion of the port authority to meet all its demands throughout the year, even in peak periods — supplemented only by a team of trainees, of approved numerical strength, each earning a guaranteed minimum wage during a maximum period of one year's apprenticeship. At or before the end of this period of apprenticeship each trainee must, if competent, be engaged as a permanent labourer.

"There are five major and four minor landing and lighterage companies at present, each employing permanent labour which is supplemented by casual labour during peak periods. Here again, the disadvantages of a multiplicity of employers is very evident."

Turning to the question of the port authority, the Commissioner states that it is necessary for all port operators to be controlled and directed by a single authority. Obviously it is in the public interest that the planning should not be entrusted to the private operators themselves either jointly or severally. Accordingly, the port authority must be reorganised and equipped with adequate personnel to undertake these important new commitments. The question must be faced seriously as to whether the complicated and specialised responsibilities of port administration should not, in the interest of greater efficiency, cease to be entrusted to a Government department.

"I strongly endorse the recommendations of the Millbourn Committee as to the establishment of a port authority with some measure of autonomy. I am not aware of any large port in any country which is efficiently administered by an authority functioning as a Government department. The scheme and constitution which I suggest as a basis for discussion are as follows:

"The appointed and elected members except the executive chairman and executive vice-chairman would serve for a period of three years and be eligible for reappointment or re-election. The executive chairman and the executive vice-chairman will be appointed by the Central Government. Two members will be appointed by the Minister of Transport and Works; one by the Minister of Agriculture and Food; two by the Minister of Labour, Housing and Social Services, in consultation with labour interests; five by the Minister of Commerce and Trade (two in consultation, with the Chambers of Commerce, and one each representing shipowners, importers and exporters), one by the Minister of Health, one by the Minister of Defence and External Affairs (representing the Royal Ceylon Navy), and one by the Colombo Municipal Council. Two members will be elected by the shipping companies, two by landing and lighterage companies, one by stevedoring company, one by oil companies and there will be two ex-officio members— the principal collector of customs and the commissioner of labour."

The board would thus consist of two executive officers, two ex-officio officials of the Government and 19 appointed or elected members. The board would exercise control over the executive through five standing committees of members, who would normally meet monthly and more often if necessary. The five committees would be: administration, finance, traffic and priorities, technical services and labour.

In conclusion the Report states that there was little risk that the board so constituted would introduce any policy which went counter to the views of the Central Government. At the same time it provided adequate representation "to those using the port in the course of business, and organisations whose interests are affected often vitally by its efficiency and success."

# Siltation Problem at Port of Barranquilla

## Constant Physical Changes Make Entrance Hazardous

By R. I. WARWICK, M.I.Struct.E.

THE entrance to the Port of Barranquilla, situated near the Caribbean coast of Colombia, about 12 miles up river from the mouth of the River Magdalena, is through what is known as the Bocas de Ceniza (literally interpreted as the mouths of ashes owing to the ashen colour of the silt laden water carried down by the river as it reaches the sea).

Legend has it that when the Spanish Conquistadores first discovered the entrances to the river (there were several outlets to the sea at that time) the ship's captain was loth to attempt the entrance owing to the forbidding turbulence and the presence of shallows, and it was only on being accused of cowardice by the leader of the expedition that the hazardous passage was attempted and carried out.

From this initial forcing of the passage followed the discoveries of the course of the River Magdalena, the setting up of the Capital City of Bogota some 400 miles south of the coast and sited on a plateau about 8,500-ft. above sea level in the mountains, and the development of what is now known as the Republic of Colombia.

At that time the main line of communication between the world and Colombia was through the Bocas de Ceniza to Barranquilla, where transhipment of goods to specially constructed light draft river craft was effected for the long and hazardous haul to the interior.

Despite the great changes in transportation methods that have developed since the initial discovery of the river entrance, and the opening of new ports on the Caribbean and Pacific coasts, this route still remains the main artery for the movement of Colombian exports and imports.

Very considerable physical changes have occurred through the years, as a result of the continuous silting up of the mouths of the River Magdalena, until to-day there is only one main outlet to the sea, and despite the efforts of many eminent engineers during the past 25 years, the entrance to the river is as hazardous to modern shipping as it was in the days of the Spanish Conquistadores, and present day ships' captains are just as loth to enter it as their historic predecessor was. and with good reason.

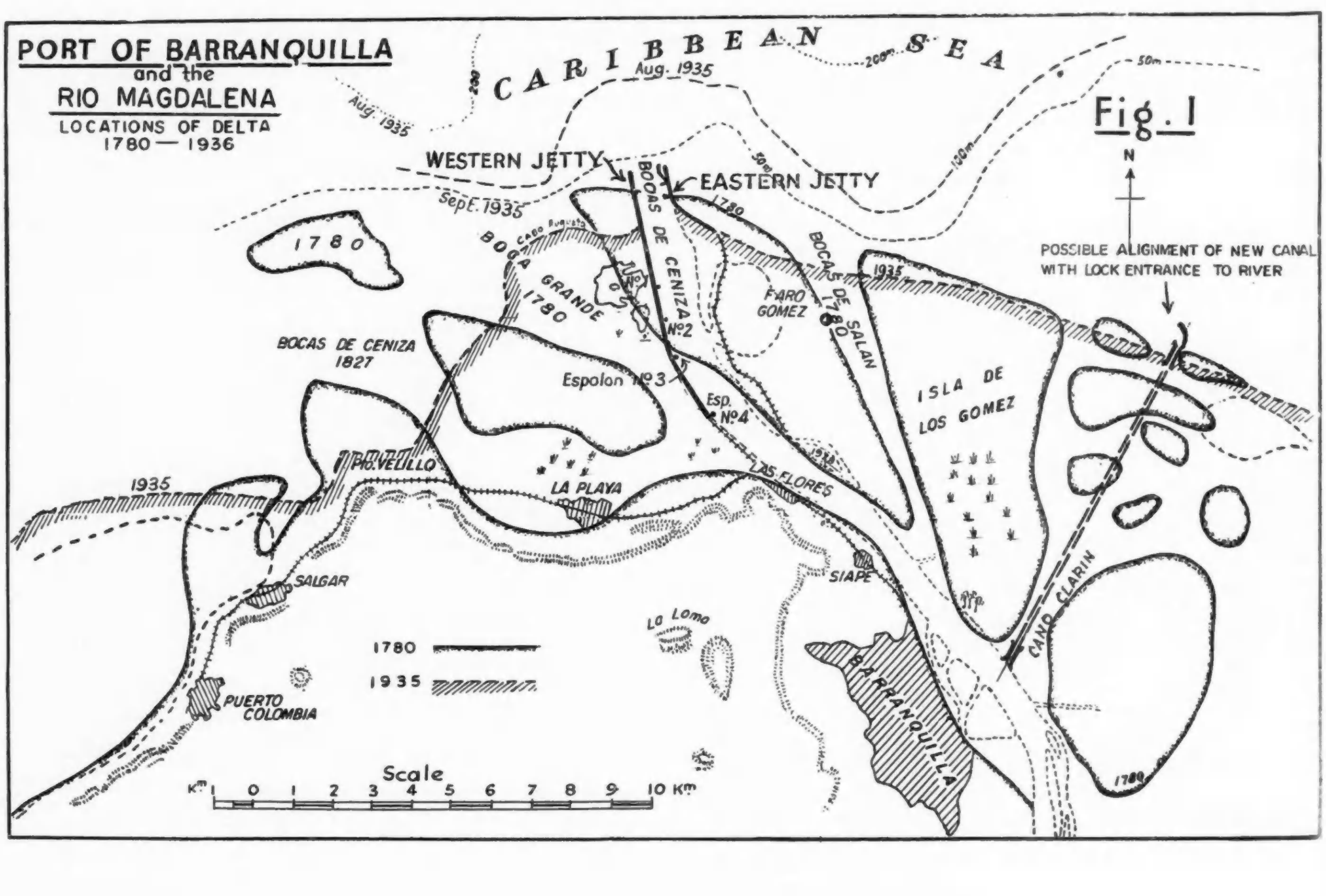
A solution to this problem is therefore still an urgent matter in the absence of adequate road and rail communications connecting the other Caribbean and Pacific ports with the capital and the interior.

The failure to deal adequately with this problem is probably due to the absence of any continuity of technical application to the matter. With every change of government fresh authorities have been appointed to study the problem and to make their own recommendations.

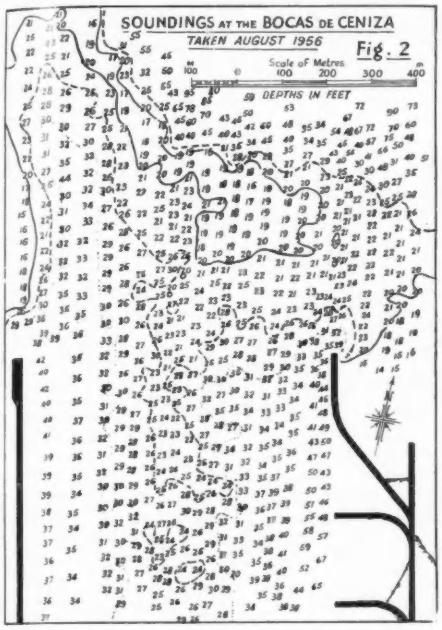
**Report on Existing Conditions.**

In January, 1956, the Author was invited, by the Junta Coordinadora del Puerto de Barranquilla, to study and report on the existing conditions at the Bocas de Ceniza, and to submit views and recommendations on the consolidation of the works already executed, and on improvements considered desirable in order to bring about a situation in which the entrance to the Port of Barranquilla could be safely assured to shipping at all times.

All previous efforts to find a solution have been based on the assumption that the con-



## *Siltation Problem at Port of Barranquilla*—*continued*




struction and extension of parallel jetties could be carried out, and that these would channel and guide the river with sufficient velocity to scour and maintain a permanent 30-ft. channel through the bar to the Caribbean sea.

The fact that to-day, following the completion between 1951 and 1954 of contraction works, designed to reduce the width and increase the depth of the channel—the depth of water over the bar is as little as 18-ft. (see Fig. 2)—offers conclusive proof that the physical conditions encountered at the mouth of the River Magdalena preclude this method of solution.

This is not to infer that the theories applied to the problem are questionable. The unfortunate fact is that the existence of the great mass of silt forming the bar, and consisting of sands of different grain sizes of both marine and river origin (clay, mud and organic matter brought down by the river) and piled up at the entrance to the narrow river mouth by the action of the salt sea mass of the Caribbean Sea, makes it a practical impossibility to construct permanent training works thereon. Indeed on two occasions, in 1938 and again in 1945, large sections of jetty which were constructed there were lost overnight when slips occurred. There was a temporary improvement in the channel following these slips, but it was only a matter of months before the bar reformed.

There exists a danger also that owing to the deteriorating condition of the Tajomar Occidental, particularly between Las Flores and espolon No. 3 (see Fig. 1), this will ultimately be breached either during a period of high river discharge, or during the period of the heavy N.E. trade winds, with disastrous consequences for the entrance to the port.

Dredging has been attempted during the past five years, but has proved completely unsuccessful owing to the turbulence of the water over the bar, even in calm weather conditions, and the viscosity of the spoil to be removed.

**Proposed New Entrance to Port.**

In these circumstances it was decided to break away from all pre-conceived ideas of improving the existing entrance to the Port of Barranquilla through the Bocas de Ceniza, and to study the possibilities of finding a suitable area for the construction of new entrance to the port.

It will be seen from Fig. 1 that the coast line east of the Bocas de Ceniza has remained compartively stable through the years; the area between the sea and the river has gradually filled up with silt brought down by the river, but the coast line remains roughly the same. To the west, however, there have occurred great changes of alignment in the coast line, brought about by the littoral drift, which is from the North East, greatly encouraged by the heavy N.E. trade winds which blow between December and April. It is this silting up which caused the abandonment of the old Puerto Colombia, and rendered the jetty there unusable. The alignment along this part of the coast varies from month to month.

An important factor in the situation is that this area of the Carribbean Sea is practically tideless. The velocity of the river at the Bocas de Ceniza varies from 0.5 M.N.P.H. during periods of low discharge, to a maximum recorded of 3.8 M.N.P.H. during periods of high discharge. Unfortunately the period of low discharge coincides with the period of the N.E. trade winds, when littoral drift might be considered to be at its highest, and the heavy wave action is working to assist the build up of the bar.

The variation in the level of the river is determined, in the virtual absence of tidal water, by the rainfall in the interior. An analysis taken over a number of years shows that, taking mean sea level as zero, the lowest low water recorded in the river at Barranquilla is plus 1-ft., and the highest high water recorded is plus 5-ft.

These factors are unfavourable to finding a solution through the Bocas de Ceniza, but are favourable when considering the provision of a new canal and a lock entrance to the river from the sea.

It was these main considerations that led to the submission of a Report to the Junta Coordinadora del Puerto de Barranquilla, recommending that the necessary marine and geological surveys should be undertaken with a view to exploring the area to the east of the Bocas de Ceniza. The aim of the survey would be to find a suitable site for the construction of a sea water canal with the necessary breakwater at the canal entrance, and with a lock entrance to the river. A site that suggests itself would have an entrance through the Cienaga del Torno, with the lock entrance in deep water nearly opposite the Terminal Maritime. It would provide for a canal approximately 300-ft. wide and capable of accommodating ships drawing up to 30-ft.

The preparation of a detailed project for a new entrance to the port obviously cannot be carried out satisfactorily until the results of these surveys are available for study, and this makes it all the more urgent that they should be put in hand with a minimum of delay.

Unfortunately, the submission of this report and recommendation to the Junta Coordinadora del Puerto de Barranquilla coincided with a Government directive relieving them of any further responsibilities for the conservation of the entrance to the River Magdalena. Therefore, once again in the chequered history of this project, there is to be yet another change of administration, and a vital engineering problem remains a matter for economic and political argument.

**Previous Attempts to Stabilise Entrance.**

Accepting the axiom that it is possible to learn from mistakes, it is felt that a brief description of the abortive attempt to contract the width of the entrance to the River Magdalena between 1951 and 1954 would be of interest. In 1945, following an extensive hydrological investigation, a report drawn up by an eminent engineer was submitted recommending that the width of the jettied channel should be reduced to approximately 490 metres.

This recommendation was subjected to careful scrutiny by the Department of Navigation and Ports in the Ministry of Public Works, and following further hydrological

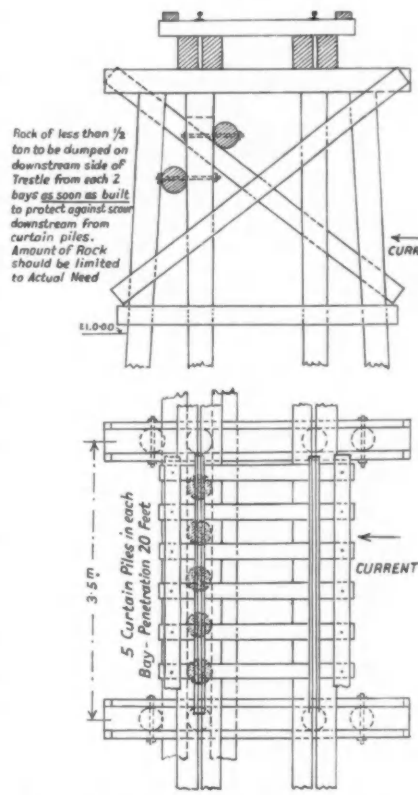



Fig. 3. Type of Permeable Dyke proposed for the contraction works of 1951/54.

## *Siltation Problem at Port of Barranquilla—continued*

investigation an alternative suggestion was put forward that the contraction of the jettied channel should be limited to 750 metres in two stages.

To resolve these conflicting views another eminent hydraulic engineer was invited to study the problem, and in 1951, as a result of his recommendation, it was decided to proceed with a project aimed at reducing the width of the jettied channel to about 610 metres.

The method to be adopted was to construct permeable dykes at right angles to the Tajomar Oriental (Eastern Jetty), as shown on Fig. 1, and to extend this jetty along the line of the reduced width.

The permeable dykes were to consist of timber piers designed to carry a broad gauge track, with curtain piles as shown on Fig. 3, and their primary function was to encourage accretion between them and thus reduce the width of the river at this point. Unfortunately they were not so constructed, and for some reason not disclosed, not one curtain pile was driven. All that was constructed was the timber pier from which quantities of rock were dumped indiscriminately into the river from both sides of the pier. A large percentage of the rock so dumped does nothing more than encourage local turbulence and scour, and thus defeats the whole object of the construction.

A further effect of this local turbulence and scour has been to undermine the timber piles until it is no longer safe to use the piers, and their ultimate collapse is inevitable. Many of the bracings have already disappeared together with some of the piles, and these structures now stand as a depressing monument to a project without merit. They are now an additional hazard to shipping forced to use the entrance to the river in order to proceed to the Port of Barranquilla.

In the general interests of the Republic of Colombia as a whole and more particularly of the City and Port of Barranquilla, it is to be hoped that a permanent Port Authority, free of any political allegiances, can be constituted, and that they will avail themselves of the technical experience necessary to proceed to a new and permanent solution of the problem of constructing a stable entrance to the port.

# Operational Hazards in the Stevedoring Industry

## U.S.A. Safety Survey Report

A survey of "Longshoreman Safety" has recently been made by the Maritime Cargo Transportation Conference of the National Academy of Science—National Research Council, Washington, U.S.A. The findings of this survey, extracts of which are given below, will not surprise many port operating officials because, in the main, they confirm a generally-held opinion that the majority of accidents arise from the human element in the work, whilst mechanical failure of gear and equipment is only a minor cause of injury. In its introduction, the report states:—

"Approximately one longshoreman out of two was injured on the job during 1954 and one out of six suffered a disabling injury. The average cost per disabling injury was estimated to be $3,400. This waste of human and material values is a serious problem in the longshore industry. The importance of this industry to the national defence and the commerce of the United States is sufficient to justify every practicable preventive effort by management, labour, and the Government to reduce the social and economic loss attendant upon accidental injury. Management has the primary responsibility for the institution of an effective accident prevention programme, labour has an obligation to co-operate and Government has a responsibility to encourage on-the-job safety.

It is recognised that longshore accidents can affect ship turnround time, increase stevedore costs, reduce productivity, damage cargo and waste valuable manpower; further, that proposed changes in handling methods will have far reaching consequences with respect to the labour force and its safety on the job."

The report goes on to state that the main purposes of this study are:

"(i) the development, analysis, evaluation, and reporting of factual information relating to longshore safety and determination of the effectiveness of existing safety practices;

(ii) the determination of possible methods of improving longshore safety practices to protect the work force and improve the industry's efficiency; and the preparation of appropriate recommendations for the action of labour, management and governmental agencies."

**Evidence of Industry Hazards.**

The body of the report deals with the evidence and incidence of accidents and also their cost and causes.

"The initial objective was to measure the degree of danger attendant upon the handling of cargo. All data available show that a high proportion of the longshore work force was injured in 1954. According to the Bureau of Labour Statistics (BLS), stevedoring had the highest injury frequency rate of any industry reported in 1954. The reported rate was 92 disabling injuries per million manhours worked as compared with the all manufacturing average of 12. The long term BLS injury frequency trend showed substantial improvement, dropping 57 per cent. between 1942 and 1950. In 1942 the rate was 138 disabling injuries per million manhours worked, as compared with a rate of 59 in 1950. Thereafter, the BLS rate increased to a post war high of 92 in 1954. This is in marked contrast with reports by the industry, which show a continuing downward trend in the injury frequency rate since 1950. In 1954 the Port of New York reported an injury frequency rate of 73 and the Pacific Coast reported a rate of 65. This could indicate that the BLS sample is too limited to reflect truly the industry injury frequency rate for the year 1954 and casts doubt upon its accuracy over the years. Nevertheless, it can be reported that the industry has made considerable safety progress over the past two decades. Despite this record of improvement, it still has a long way to go towards control of the injury frequency rate. It is difficult to determine an industry "norm" but it has been noted that some stevedore establishments consistently operate at rates below 20.

**Accident Statistics.**

The Bureau of Employees' Compensation, which administers the Longshoreman and Harbour Workers' Compensation Act, reported 28,000 shipboard injuries in 1954, of which there were 10,000 disabling or lost time injuries. Of the lost time injuries, about 75 per cent. were compensable (that is, of more than seven days' duration), with compensation payments amounting to about $5,000,000. Since Federal jurisdiction extends only to shipboard accidents we were unable to obtain national dock accident statistics. New York and Pacific Coast data, however, showed that from 70 to 75 per cent. of all longshore accidents occur aboard ship. Accordingly, the total number of longshore accidents was probably in the neighbourhood of 40,000 and of these there were probably about 14,000 lost time injuries.

The average time lost for disabling injuries was 118 days, largely the reflection of permanent total or permanent partial disabilities. Approximately 60 per cent. of the incurred loss, both time and money, is attributable to permanent total and permanent partial disability cases. This is a rough measure of the industry severity rate, of which BLS reported in 1954 that stevedoring had the highest severity rate—17.2—of any industry. The severity rate is the average number of days lost as a result of disabling work injuries, for each 1,000 employee-hours worked. The computation of days lost includes standard time charges for fatalities and permanent disabilities.

**Accident Costs.**

Workmen's compensation costs are a significant element of stevedore cost and they can be materially reduced through an effective accident prevention programme. In the Port of New York workmen's compensation and public liability insurance comprise 11 per cent. of the stevedore labour cost and the insurance rate is set at $13.00 per $100 of payroll.

According to BEC, the average compensation cost per non-fatal

## *Operational Hazards in the Stevedoring Industry—continued*

shipboard injury case closed during fiscal year 1954 was $655. Medical cost for such an injury is estimated to be about 40 per cent. of the compensation cost or $262, making a total direct cost per compensable accident of $917. If we accept a four to one ratio of indirect to direct costs, then the average non-fatal compensable injury may have cost as much as $5,000. This indirect cost includes administrative costs to process a claim, legal fees, cargo damage, loss of productivity, etc. Thus the non-fatal lost time accident cases closed during fiscal 1954 might have cost the industry as much as $70,000,000.

This cost is covered by the stevedore through an insurance programme. The manual rate established for this type of insurance indicates the immediate cost to the stevedore. It is usually a composite rate set by an insurance rating bureau reflecting both state and federal laws. Since state laws vary, and both the state and federal laws are administered differently in different jurisdictions, it is difficult to ascribe significance between ports. The rate which is expressed as a per cent. of total payroll runs as low as $3.75 per $100 of payroll in Virginia to a high of $19.44 in Alaska. A federal law recently enacted raises maximum compensation payments to injured longshoremen from $35 per week to $54 and minimum weekly benefits from $12 to $18. The new measure reduces waiting time from seven days to three days before an injured longshoreman becomes eligible for benefits. It also provides for benefit payments for the entire period of the injury for employees off the job 28 days as compared with a 49 day injury period in the old act. These increased benefits to injured longshoremen will raise accident costs. This should provide the industry with a stronger incentive to reduce the accident rate.

**Accident Causes.**

Statistical data on a national basis with regard to longshore safety are inadequate. Some governmental agency should be given authority and funds to develop such data on a regular basis. Accident data from governmental sources (BEC) merely show the accident type and nature of the injury. They fail to show the basic causes of longshore accidents. From other data it was found that the majority of longshore accidents occur while hand handling cargo. Mechanical failure of gear and equipment is a minor cause of injury.

Analysis of Pacific Coast data showed that in 90 per cent. of the reported accidents a human element accident cause was involved, whereas less than 30 per cent. of the accidents involved an environmental cause (i.e. a physical defect or inadequacy which should be corrected or controlled to prevent a recurrence). These and other data led to the conclusion that longshore hazards can be sharply reduced by positive and unremitting safety education of the workforce; by improved materials handling methods; by increased mechanisation of the materials handling system itself, particularly in the hold; and by attention to the proper design of facilities and cargo handling gear. This recommendation implies the need for regular gangs, the ability of management to direct its work force and effective labour co-operation.

In most industries materials handling has always been a prolific source of injuries. Probably no other phase of modern industrial production has received more safety engineering attention or undergone more radical change than has materials handling. Longshoring is basically a materials handling process and as such is hazardous work. The stevedore industry, except for the handling of bulk cargo, has not kept pace with industry in general, where the trend towards mechanisation has tended to overcome work hazards.

It should be noted, however, that the stevedore industry has a number of unique factors which intensify the hazards and tend to make safety work unusually difficult. The intermittent nature of the hiring process makes it difficult for a single employer to train his work force or issue necessary personal protective equipment, but he can participate in port-wide training activities. The long hours of work in some ports and rotation of the work force also complicate the picture, as does the poor labour-management relationship. These problems must be resolved if the industry is to reduce its injury frequency rate.

Another disturbing factor is the approach of some stevedore establishments towards safety. They are reluctant to undertake the expense of safety personnel or technical assistance, rarely keep good accident statistics or detailed cost figures, and are thus ignorant of the underlying causes of accidents and their real cost. In short, more stevedore establishments must be convinced of the need for an effective safety programme. Safety should not be subordinated to other considerations. Shipping concerns which contract for stevedore services should realise that they are indirectly paying for poor safety performance. There must be a greater degree of co-operation between shipping companies and contract stevedores in the field of accident prevention.

Failure to provide a safe place to work is an additional factor contributing to cargo handling accidents aboard ship. In maritime law this is the absolute and non-delegable responsibility of the shipowner. As a factor in accident prevention, it is the shipowner's duty to maintain safe working conditions on the vessel. It is the duty of the Master of the vessel to supervise loading and discharging of cargo to assure the safety of the vessel at sea."

**Recommendations.**

In the final section of the report it is recommended that:

" 1. The Department of Labour be given the means to carry out fully the provisions of existing legislation to make continuous studies and investigations with respect to safety provisions and causes of injuries aboard ship; and, with the co-operation of the various states to develop similar data covering dock operations.

2. On the basis of information developed as a result of recommendation 1, the Department of Labour, in consultation with other interested agencies and organisations, promulgate safety standards and seek voluntary compliance with these standards.

3. The National Safety Council expand its activities in the marine transportation field to place greater emphasis upon longshore safety problems.

4. The Department of Labour, with the co-operation of longshore labour and management, and other interested agencies and organisations, develop effective programmes for the training of longshore workers in safety practices, and persuade longshore management and labour to implement these programmes.

5. Shipping companies encourage their stevedores to institute effective accident prevention programmes.

6. An appropriate national body, such as the National Safety Council, sponsor an annual safety awards competition for the stevedore industry similar to the Harriman Gold Medal Safety Award competition among the railroads of the United States.

7. Safety should be a wholly justifiable end in itself rather than a means to obtain employment benefits such as higher wages or expanded employment opportunity."

This MCTC report emphasises how difficult is the solution of the problem of safe working in a country as vast as the U.S.A., especially bearing in mind its separate state laws. The undoubted usefulness of the survey is, of course, that it again draws attention to this important matter stressing that, besides reducing danger to life and limb, adequate attention to safety can save costly loss of time. In British shipping circles it is often stated that the aim of port operators is speed of handling with care of cargo and safety of personnel. It is not always appreciated that these three essential requirements need not conflict.

**Extension of Handling Facilities for Port of Stockton.**

It has recently been announced that final plans have been agreed and preliminary construction commenced on a scheme to double the bulk ore landing capacity at the Port of Stockton, California. An additional wharf is to be built which will allow two ships to be loaded simultaneously and will carry a further loading tower and conveyor system which will increase the loading rate to 1,000 tons per hour per vessel. The present stacker trestle will be extended to create an additional stockpile area of approximately 100,000 tons, thus providing a total stockpile of a quarter of a million tons of iron ore.

# Manchester Ship Canal's Radio-Communications System

By F. GRONBACK

Ships of up to 14,000 deadweight tons bound for Manchester can now navigate the 35½ miles long Manchester Ship Canal more quickly and easily since the installation of a high frequency radio telephone network. This system, operated in conjunction with land line telephones between the dock offices at Manchester and the major bridge and lock installations, provides regular, reliable up to the minute information to the Harbour Master's office where the position and progress of every ship on the canal is plotted on a chart, drawn up like a railway operating timetable.

Between Eastham on the River Mersey and Manchester Docks ships must pass through five lock systems and nine swing bridges and there are four points where ships cannot pass each other. Thus rigorous control must be imposed on all shipping movements. Before radio telephone equipment was installed, operating instructions were based on information supplied by telephone from the lock and bridge installations. Between these, however, were stretches of canal from which it was impossible to relay reliable information on whether expected speed was being maintained or of any other operational difficulties. As a result precautionary measures, such as the hold up of a ship approaching a one way stretch of the canal, had to be taken frequently and often needlessly.

Now 22 of the Ship Canal Company's fleet of 26 tugs are equipped with radio telephone receivers and are able to communicate precise details of position and speed from any point of the canal to one of three control rooms.

These are situated at (a) the Dock Offices, Manchester; (b) Latchford Locks, about the half-way point; and (c) Eastham Locks. Thus the greater part of the canal is covered by two land stations. At each, a 24 hours watch is maintained by special staff. Control points do not use radio to communicate with each other because they were well served by land lines; tugs cannot talk directly to one another but relay messages through one of the control stations.

How mobile radio assists ship canal operations was explained by Capt. L. G. Richardson (Harbour Master). "This is a facility which we take much for granted now. How we managed before I do not know," he said. "To-day it is an integral part of canal communications. My control room has an up to the minute picture of the exact location and speed of every ship on the canal and with this bird's eye picture it is possible to plan forward. Waiting time is reduced, traffic kept moving smoothly and movement orders speedily and confidently transmitted.

One of the most frequent decisions is when to instruct a ship to wait in one of the lay-bys for another ship to pass. Information is received from the tug—most ships using the canal need the assistance of a tug for at least part of the journey—or in some cases from the ship herself. Thus it is possible, when a slow moving liner is in the vicinity of a narrow stretch to decide whether a fast moving vessel can be rushed through or whether she should wait. Similarly slow moving ships can be instructed to wait at Lay-by X until the s.s. ——— has passed in the opposite direction.

The advantages of mobile radio have been quickly realised by steamship owners regularly using the canal. A surprising number, notably those of Manchester Liners Ltd. and coasting vessels, are equipped with radio equipment which can operate in the channels of port and harbour authorities. For example, a coastal ship in the Pomona Docks at Manchester which has finished loading can call up the dock offices by radio telephone and seek permission to sail. Within five to ten minutes of the permission being given, the ship can be under weigh and in meantime information will have been flashed to locks and bridges giving information on the approximate times she will need service.

Where two ships are hove to awaiting the order to proceed it usually happens that one is either equipped with radio operating in the Canal network or has the service of a radio equipped tug. If one ship moves off the other knows that information has been received by radio and that she, too, can sail. Before the days of mobile radio no ship could or would move without first having permission from the Harbour Master's staff.

Away from the routine canal operations, mobile radio has assisted in the prompt detection of fire and in saving life. On one occasion, the screams of a boy were heard by a passing ship. Details of the occurrence were flashed to Manchester, an investigation started and a frightened youngster was found clinging desperately to a fender at the canal edge. Several fire alrms have been raised by ships using mobile radio. One in a railway wagon on the dock estate might have proved serious.

Here are the details of the V.H.F. equipment all of which was

(Right): A pilot on board a large cargo liner receiving instructions from control by means of one of the portable sets.
(Left): The Captain of the latest hydroconic tug "Sabre," receiving instructions from the control room at the dock offices, Manchester, by means of radio telephone.

## *Manchester Ship Canal's Radio-Communications System—continued*

Controller at Ellesmere Port plotting on the graph the position and course of every ship. He is one of the three controllers—the others being at Latchford and Manchester.

installed by Automatic Telephone and Electric Co. Ltd. The installation comprises 25 amplitude modulated transmitter/receiver sets each having an output power of 10 watts and the facility for operating on any of six crystal controlled frequencies within the V.H.F. band 156—184 mc/s. Shore installations are powered from the usual 230 volt A.C. mains and the shipborne equipment, which includes loudhailer facilities, is connected directly to the ship's 110 volt D.C. supplies. At the terminals uni-directional aerials, mounted on poles located on the control buildings are used to direct transmissions up or down the canal. At Latchford, a 70-ft. lattice steel mast carries a bi-directional array to beam transmissions in both directions. Omni-directional dipole aerials are fitted in the tugs.

The system operates on the Simplex principle in the following manner: Frequency channels 5, 6 and 7 are allocated to Manchester, channels 4, 6 and 7 to Latchford and channels 6 and 7 to Eastham. Channel 6 is used as a common calling channel for all vessels and the shore stations maintain a listening out watch on this frequency. Once communication has been established the control station asks the vessel to change frequency to the station operational channel. These are No. 4 for Latchford and No. 5 for Manchester. At Eastham channel 6 is also the operational channel. Channel 7 provides communication between the fixed stations and the tugs. The frequency frequency of channel 6 is also common to the extensive V.H.F. communications scheme of the Mersey Docks and Harbour Board. Thus any vessel equipped to operate in the M.D. & H.B. scheme can talk into the Manchester Ship Canal network and vice versa. This is important because all traffic arriving at or leaving the canal has to pass through the Mersey estuary.

This link up is interesting because incoming ships and ships which have part unloaded at Liverpool before proceeding to Manchester, can when they are fitted with suitable equipment, speak into the Ship Canal network. Although much information is made available in advance by the agent, there have been many occasions when details of draft, tug requirements, etc., have been relayed from the ship to Eastham and this has expedited the handling of the ship when she entered the canal. Details of the journey to Manchester or to any intermediate berth can be worked out in advance.

Manchester Ship Canal not only provides access to Manchester Docks but is also an elongated system of docks for between Eastham and Manchester there are about 50 wharves and quays, some privately owned, where ships can discharge their cargoes close to the works and factories where they will be utilised. Some ships may make two or three "drops" along the canal. Thus mobile radio assists the efficient movement of ships between intermediate quays with minimum interference with vessels proceeding all the way to or from Manchester.

There is little doubt that mobile radio, installed in 1954, is playing some part in increasing traffic at Manchester. Tonnage figures increased from 12,485,071 tons (£3,083,075) in 1953 to 18,563,376 tons (£4,146,502) in 1955.

# Dock and Harbour Authorities' Association

### Extracts from the Annual Report for 1956

In the 37th Report of the Dock and Harbour Authorities' Association, published last month, it was stated that the Association welcomed certain provisions of the Finance Act, 1956, which effected two important alterations in the law relating to income tax upon which the Association had recently made representations to the Treasury, namely, that capital allowances should be payable in respect of expenditure incurred in cutting, tunnelling and levelling land and should also be allowed in respect of capital expenditure on dredging.

Among the provisions of the Bill for the Act with which the Association were concerned was that regarding suspension of investment allowances (with certain exceptions).

This section suspended the investment allowance with effect from the 17th February, 1956, subject to certain exceptions including an exception in respect of capital expenditure in so far as it consists of sums payable under a contract entered into on a date not later than the 17th February, 1956.

The Association pointed out to the Inland Revenue the hardships which would result to those port authorities carrying out work by direct labour who would not be able to claim the benefit of the exception although they might already be committed to a large works programme involving heavy capital expenditure which would have to be completed.

It was suggested to the Treasury that this unfair distinction between those authorities carrying out work by direct labour and those employing contractors should be met by the addition of a provision enabling the Treasury to sanction, for the investment allowance, capital expenditure incurred after the 17th February, 1956, where they were satisfied that the authorities concerned were committed to the work at that date and that it would not be prudent to suspend it. In addition, at the Committee Stage in the House of Commons, the Parliamentary Chairman supported an amendment which would have given effect to this suggestion but the Government were not prepared to amend the Bill and the amendment was withdrawn.

The Government fully appreciated the unfair position which would result from the section but took the view that the suspension must be effected from a definite date, though at the same time authorities who were party to a contract must be protected, as if they failed to carry out the contract, they might be subject to a penalty.

Another provision in which the Association was interested was that referring to capital allowances for industrial buildings, expenditure on cutting, tunnelling, etc.

Reference was made in the Annual Report for 1955 to the representations which the Association had made to the Treasury, in conjunction with the Dry Dock Owners' and Repairers' Central Council, that expenditure incurred in excavating land for the extension or construction of a dock, which may form a large part of the total cost of the work, should rank for depreciation allowance under the provisions of the Income Tax Act, 1952.

In this present Annual Report it was stated that the Association were glad that the Chancellor of the Exchequer thought it right to meet the views of the Association and the Council and to include this section which made the necessary alteration in the law. The point involved is an important one to port authorities, particularly in these days when the cost of dock construction is so high.

## *Dock and Harbour Authorities' Association—continued*

On the question of capital allowances for expenditure on dredging the Association welcomed the provisions of the section concerned, which gave effect to other representations made by the Association to the Treasury, which were referred to in the Annual Report for 1955, that capital dredging should qualify for the investment allowance in the same way as expenditure on the construction of docks qualifies in the Finance Act, 1954. The clause in the Bill as introduced, however, was defective in that it limited the expenditure which would qualify for the investment allowance to expenditure on dredging for the benefit of vessels coming to, leaving or using any dock or other premises occupied by the authority responsible for the dredging.

The Association pointed out to the Inland Revenue that this wording would not cover all cases which might arise, including dredging carried out by a conservancy authority which had no dock undertaking. An amendment to cover all forseeable cases was agreed with the Inland Revenue and was accepted by the Government.

The modification of the law effected by this section is again of considerable importance to port authorities and conservancy authorities who may be concerned in carrying out increased capital dredging to improve the depths of approach channels and to cater for the large ships which are being brought into use. The section will effect a considerable financial saving to a number of authorities.

**Clean Air Act, 1956.**

The main points with which the Association were concerned on the Bill for this Act were set out in the Annual Report for 1955. The result of the representations made by the Association on these points was as follows:

(i) Authority responsible.

The Bill, as introduced, provided that local authorities were to be responsible for enforcing its provisions and the Association believed that this would lead to practical difficulties in ports where several local authorities were concerned and that a port health authority, where one existed, should be responsible for enforcement. The Ministry of Housing and Local Government were apparently advised that the Bill as introduced gave the necessary enforcement powers to port health authorities to the exclusion of local authorities in the area concerned, but the Association did not agree with this view and believed the drafting of the Bill was defective if it was intended to have this effect.

The Association were not able to obtain satisfaction on this point, and therefore they arranged for the necessary amendment to be set down at the Committee Stage in the House of Lords and took the opportunity to include a further amendment whereby new port health authorities to be set up would automatically become responsible for enforcing the provisions of the Act in relation to vessels, instead of this being dependent upon an Order made under the Public Health Act, 1936, the making of which is permissive. The Ministry of Housing and Local Government eventually realised that some amendment was necessary and the Government themselves set down an amendment which removed the defect in the drafting of the Bill. In view of the Government amendment, the Association did not press the further point they had raised and their amendment was withdrawn.

The result is that port health authorities which already exercise jurisdiction in respect of vessels will continue to do so, and that where a new port health authority is set up, the Minister may transfer the enforcement of provisions of the Clean Air Act, 1956, to the port health authority. In view of this, the possibility that a vessel emitting dark smoke whilst under way might be prosecuted by more than one local authority for what was the same continuing offence is minimised by the fact that a port health authority is now to be responsibie for enforcement.

The Association also arranged for an amendment to be set down at the Committee Stage in the House of Lords, limiting the application of the Act to waters within the seaward limits of the territorial waters of the United Kingdom, and this amendment was accepted by the Government and became part of section 19 of the Act.

Under the Act the Minister has power to make regulations prescribing the period during which the emission of dark smoke is to be disregarded for the purposes of the Act. The Chamber of Shipping have been considering this matter in relation to shipping generally. They have reached the conclusion that different periods will have to be prescribed to meet different circumstances and the Association have agreed that the periods recommended by the Chamber of Shipping will be sufficiently long to cover the operation of vessels belonging to port authorities.

It is therefore hoped that the draft Regulations, when introduced, will be satisfactory, but the Association are to be given an opportunity to make representations if they consider that the periods to be prescribed are not adequate.

**Road Traffic Act, 1956.**

It will be remembered that the Bill for this Act, which was a second Bill introduced in June, 1955, omitted the provisions which were contained in the original Bill relating to the testing of vehicles. At the Report Stage in the House of Commons, however, the Minister of Transport and Civil Aviation introduced a new clause enabling the Minister to make regulations providing for the examination and testing of motor vehicles, in similar terms to the original clause with which the Association were concerned.

The Association accordingly again asked the Ministry for an assurance that any regulations would exclude fork-lift trucks, electric trolleys and all other port authority vehicles which are normally used on roads not repairable at the public expense, but the Ministry took the view that the appropriate exclusions should be considered when the regulations come to be made.

The Association will continue to watch this matter and, if necessary, make further representations when the draft Regulations are issued.

**Limitation of Shipowners' Liability.**

(i) **Section 74 of the Harbours, Docks and Piers Clauses Act, 1847.**

During the year a point arose out of the decision of the House of Lords in the case of the "Stonedale No. 1 ([1955] 2 Lloyd's Rep., 9) when it was decided that the right of a shipowner to limit liability under section 1 and 3 of the Merchant Shipping (Liability of Shipowners and Others) Act, 1900, only extends to claims in damages and does not apply to a claim made under a statutory right to recover in full expenses incurred in raising a sunken vessel.

Although the point did not arise directly in the particular case, a member of the Association was advised by Counsel in connection with a claim for damage to works that, having regard to the decision in the "Stonedale No. 1," a shipowner has no right to liability on a claim made under section 74 of the Harbours, Docks and Piers Clauses Act, 1847, as incorporated in a local Act or Order, even though the damage has been caused by the improper navigation or management of the ship. This expression of opinion was contrary to the view held by the Association and, in view of the importance of the matter to members of the Association, it was decided to take the opinion of Counsel directly on this point. A Case was accordingly submitted to Mr. A. A. Mocatta, Q.C., who has confirmed the view held by the Association that a claim under section 74 of the Harbours, Docks and Piers Clauses Act, 1847, is a claim in damages to which the limitation provisions of the Merchant Shipping Acts apply.

Counsel has also advised that the position is the same where a port authority exercise their right of detention under section 74 and that they cannot, by exercising this right of detention, recover an amount in excess of the amount of the limitation fund.

The International Maritime Conventions Sub-Committee considered the practical application of Counsel's opinion and reached the conclusion that, where a port authority exercises the right to detain a vessel in respect of damage to dock works, they should not release the vessel unless—

(a) the shipowner has deposited with them an amount equal to the total amount of the damage to the dock works; or

(b) the vessel is ordered to be released by the Court on limitation proceedings, in which case the order should make it clear that the port authority retain their right of priority against the limitation fund.

## *Dock and Harbour Authorities' Association—continued*

(ii) **Draft Convention.**

During the year the Association have had meetings with the Ministry of Transport and Civil Aviation, the Chamber of Shipping and the Liverpool Steam Ship Owners' Association on the terms of the draft Convention which was agreed by the Comité Maritime International at a Conference held in Madrid in September, 1955, and to which reference was made in the Annual Report for 1955.

The main point under consideration has been the reservation contained in the footnote to Article 1 of the draft Convention under which the High Contracting Parties reserve the right to exclude wreck liability from the Convention. This footnote has been added to meet the special position in the United Kingdom where port authorities have enjoyed the right to recover wreck removal expenses in full—a practice which differs from that abroad where limitation has been allowed in respect of such expenses.

The draft Convention is to be considered at a Diplomatic Conference to be held in Brussels in 1957 and as Her Majesty's Government are anxious that international agreement should be reached, they desire, if it is possible, to dispense with the need for the reservation. The Association, for their part, have said that they are willing to co-operate in seeking a solution, provided that port authorities are fully covered by some other means in respect of the whole of the cost of wreck removal.

The Chamber of Shipping have suggested that the point at issue will be covered in the future, if the proposed Convention is implemented, by reason of the fact that under its terms the amount of the limitation fund in respect of damage to property, will be increased from £8 to £24 per ton, which should, in their view, prove sufficient to meet the claims of port authorities in full. The Association, however, do not accept this view for a number of reasons and have insisted on some absolute form of protection.

A proposal to remove the need for the similar footnote to the 1924 Convention was last considered in 1947, when the Association had meetings with the Ministry of Transport and the shipowners' representatives. At that time the Association suggested the setting up of a wreck fund which was to be created and maintained by means of special dues levied on vessels and was to be available to meet the costs and expenses properly incurred by port authorities in respect of wreck removal over and above the amount which port authorities would be able to recover from any limitation fund set up by the shipowner concerned. The Chamber of Shipping suggested a form of group insurance against similar losses, but the Association felt that there were serious objections to this method and preferred the setting up of a wreck fund.

The Association have again promised to consider both the proposals for a wreck fund and for a scheme of group insurance on the understanding that, if agreement is reached on an alternative method of protecting port authorities, statutory effect will be given to it in the legislation which will be necessary to implement the Convention, if it is agreed.

**V.H.F. Radio Telephony.**

In the past the proper development and expansion of maritime mobile V.H.F. radio telephony services has not taken place because of a lack of international agreement and planning, which is necessary if shipowners are to be able to install a single equipment on board ship which is capable of operating in all ports of the world.

A step forward was taken at the Baltic and North Sea Radiotelephone Conference held at Gothenburg in 1955 when the question of an International Service was discussed informally, and consideration was given to the allocation of frequencies. During the year further progress has been made and, after consultation with the interests concerned, the United Kingdom and the Colonies have formally accepted the proposed allocation of frequencies which was informally agreed at Gothenburg.

The question of an International Service was also considered at the 8th Plenary Assembly of the International Radio Consultative Committee, which was held in Warsaw in August, and is to be further considered at an International Conference to be held at The Hague in January, 1957.

The Conference at The Hague will consider all matters which require international agreement, including the preparation of a frequency plan which meets the requirements of the various services and standardisation of rules of procedure for establishing contact.

**Damage to Dock Works.**

For some time the Association have been concerned at the amount of damage which is caused to dock works as a result of the breakdown of the controlling machinery of vessels or the incorrect interpretation of bridge telegraph orders by the engineer on duty. There have been a comparatively large number of such cases over the last few years, and in some instances the resultant consequences are far more serious than the immediate damage, particularly where dock gates are damaged and a whole dock system put out of action.

The Association therefore believe it to be important that all practicable steps should be taken to minimise the risk of damage being caused to dock works in one or other of these ways. With this end in view they have asked the Chamber of Shipping, the Liverpool Steam Ship Owners' Association and the British Tugowners' Association to join in discussing the problem, and it is hoped that a meeting will be held early in 1957.

# Cargo Handling in some Far Eastern Ports

### Comparisons between Methods Employed

By JAMES STEEL*

Whilst visiting in recent months several of the larger ports of Australia, New Zealand, the Philippine Republic, and Japan, I have been impressed with the great difference between the numbers of mechanical aids to cargo handling used in each, the choice of machine, and the variety of ownership.

The speed of air travel encourages these lightning tours of vast areas, which provide but a day to study a port area which merits a month's observance. I realise therefore that the following comments are superficial rather than incisive. The opportunity of seeing cargo handling in several ports in quick succession does, however, facilitate comparisons which would be obscured and perhaps biased by a longer tour.

Of the four countries visited in the course of this journey it is an obvious generality that the European influence is most evident in New Zealand ports, and the United States influence in the chief port of the Philippine Republic, Manila. In Australia the provision of shore-based equipment varies considerably, as does also its ownership, type, and use; and there is no uniform pattern. Melbourne leans more to the European tradition and Sydney to the North American. In Japanese ports the American influence is strong, but the mobile shore-based cargo handling plant which is abundantly apparent in the ports of U.S.A. and Canada is almost completely lacking; manual work is employed on a scale that would be wholly uneconomic in the West.

To examine these facilities and methods more specifically I shall start in New Zealand, which has sixteen excellent ports operated by separate Harbour Boards. The only one I visited in the South Island was Port Lyttelton, which serves Christchurch and the great agricultural area around it. This lovely land-locked harbour set amongst green hills has some 12,500-ft. of wharves and jetties, the port area including the piers is well covered by railway lines; cargo is usually discharged direct into or loaded from rail trucks, and extensive sheds are not needed. The berths are well provided with electric portal cranes of 3-ton and 5-ton capacity, of which there are 28. Heavy lifts are made by an 80-ton floating crane. Considerable extensions to this busy port are planned; these may give opportunity for the economic use of mobile plant.

Wellington, at the southern tip of the North Island, has several

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## *Cargo Handling—continued*

deep water berths well provided with handling plant. The port area, which consists of Port Nicholson Harbour and Queens Wharf, has a large number of sheds for storage of wool and these are equipped with overhead travelling cranes. Standard gauge rails serve three wharves but the Wellington Harbour Board, which acts as wharfinger, has also provided a fleet of 40 to 50 tractors with 400 to 500 trailers for the rapid movement of cargo to and from the wharf aprons. Good use is also made of diesel/electric rubber tyred full-circle-slewing mobile cranes which load, carry, or stack the larger items of cargo up to 5 tons; there are about 20 of these important aids to efficient handling. The dockside cranes are mostly hydraulic, and of these there are some 60 portal cranes on wide gauge rails of 2 or 2½ ton capacity, with a small number of 3-ton electric portal cranes, and five stationary hydraulic cranes. Coal is handled by electric grabbing cranes. For heavy lifts there is a 10-ton fixed hydraulic crane and an 80-ton floating steam crane. This port is, therefore, well provided with suitable plant, both fixed and mobile, equipped with sheds, and served by railways, all efficiently owned and operated by the Harbour Board, so that cargo handling here is both speedy and economic.


Loading drums into a vessel from a lighter, in the Port of Sydney.

Auckland Harbour, magnificently situated in an almost land-locked estuary, a total of about 27,000-ft. of modern concrete wharves providing deep water berths for ocean-going and coastal ships in about equal proportions. The Harbour Board owns all cranage and hires it out complete with drivers to stevedores. The port is particularly well provided with 64 electric portal cranes of 3-ton and 5-ton capacity, and an 80-ton floating crane. Like so many other progressive port authorities, however, it has found it necessary to augment this fixed plant with a fleet of mobile plant which keeps the cargo moving to and from its single or double storey sheds, and so prevents congestion on the wharves. This authority has wisely selected the best from a variety of mobile plant to achieve economic handling: fork-lift trucks for palletised loads which require stacking; the tractor/trailer system for long horizontal movement; and a fleet of 14 mobile cranes of 1 to 6 ton capacity for carrying, loading, and stacking in large unit loads. It has latterly bought the modern diesel/electric mobile crane for ease of handling and minimum running and maintenance costs. Contractors may only use their own mobile plant if the Harbour Board's fleet is fully employed and the machines work on average at least 6 hours every day.

We come now to the chief ports of Australia, and find great diversity in the employment and ownership of mobile plant. The Queensland Department of Harbour and Marine controls the port of Brisbane, situated 10 miles up the River Brisbane. Here there are no piers, but a number of wharves on either side of the river— Railway Wharf, Bretts Wharf, and Newstead Wharf—which are served by travelling wharf cranes, either steam or electrically operated, of 3 tons and 6 tons capacity, with a few larger cranes of 10, 12, and 15 tons capacity, and a 40-ton steam crane on Bretts Wharf. There is a conveyor system for loading butter. I saw no mobile plant in evidence owned by the port authority. Ships are loaded and discharged by the three or four important stevedoring companies, who have an odd unit or two of mobile plant, but it is surprisingly absent in this busy port of growing significance.

Sydney's magnificent port needs no description, for it is one of the world's most perfect and beautiful natural harbours. As the main port of entry to Australia, it is blessed with nearly five miles of fine wharves, but is singularly lacking in cranage. Administration is in the hands of the New South Wales Maritime Services Board, but all working of ships is done by one of the several large stevedoring firms who provide their own mechanical handling plant independent of the port authority and one another. There is a Titan floating crane of 150 tons capacity owned by the Maritime Services Board, but most cargo is handled by ship's gear.

Conditions are quite different in Melbourne, where the Melbourne Harbour Trust administers a port area covering 20 square miles. The berths are divided amongst Port Melbourne itself (8), Williamstown (12), the lower Yarra (14), and the River Yarra (71), making a total of 105 berths. The berths are at piers in Port Melbourne and Williamstown, and at wharves on the Yarra. A total of 58 sheds is available for cargo and the wharves are served by 27 modern electric level luffing cranes. In addition there are 2 larger shore-based cranes — a 60-ton steam crane and a 35-ton hydraulic crane — and also a 40-ton floating crane. This plant is supplemented by a large fleet of mobile cranes of 1¼ to 5 ton capacity—mainly diesel/electric—fork-lift trucks, straddle trucks, and wool stackers. All this plant is available for the private stevedoring companies to hire by the hour or the day, complete with drivers. All working of the ships and handling of cargo is done by private stevedoring companies.

Geelong is a much smaller port of Victoria, which I also visited, and is of growing importance because of the motor car industry. Entrance is by a short channel and ships are berthed at two piers, the Yarra and the Cunningham, each about a thousand feet long by twenty-nine feet wide, and at the Corio Quay. Cargo handling plant is notably absent, and all loading and discharge is by ship's gear. I understand the Geelong Harbour Trust Commissioners plan to instal wharf cranes, but meanwhile have only 4 non-slewing mobile cranes which operate somewhat awkwardly on the narrow piers.

The South Australia Harbour Board operates the fine port of Adelaide, which comprises an outer harbour and an inner harbour six miles up the River Murray; there are three miles of wharves equipped with large modern transit sheds. There is a coal handling plant at Osborne Wharf, a 60-ton Goliath crane and two floating telpher systems. The huge fleet of mobile plant in this port is not, however, owned by the Harbour Board, but by a private company, the Port Adelaide Haulage Company, formed to operate a pool of mobile plant, and owned by three or four of the largest stevedores. This company owns and operates 135 tractors and trailers, 24 fork-lift trucks, and seven small mobile cranes, which it hires out on an hourly basis to the stevedores. Most of this plant is American, and I was impressed by the obvious failure of the tractor drivers to take full advantage of their machines. I never saw a tractor pull more than one trailer at a time, and the driver waited while it was being loaded or unloaded, thus defeating the chief object of the tractor/trailer system. The owners and hirers were, of course, fully alive to the uneconmic use of the machines, but could not change the practice because of Union regulations.

Fremantle is the chief port of Western Australia, and on its imports and exports the whole prosperity of the State depends. The progressive outlook of this Harbour Trust and its General Manager

*Cargo Handling—continued*

in future planning is known throughout the world, and it was therefore a particular privilege to be shown around the port by the General Manager. Many recent improvements, such as modern single-storey sheds, give evidence of his theories being put into practice. Wheat is the chief export, and this is handled in bulk by conveyors into the ships' hold. There is a wharf frontage of over 10,000-ft., most of which is served by electric gantry cranes of varying capacities up to 20 tons. There is a floating crane of 80 tons capacity for the occasional very heavy lift. Ship's gear, electric cranes, and conveyors are all used for handling the vast tonnage of imported general cargo direct into rail trucks or into sheds. The Harbour Trust invested some years ago in a fine fleet of almost 30 modern diesel/electric full-circle-slew mobile cranes, and these have performed magnificently in clearing wharves, stacking in sheds, and loading road and rail transport. All the cargo handling plant is owned by the Harbour Trust and hired out to stevedores.

The Port of Albany is also in Western Australia, but it handles a relatively small tonnage. Ocean-going ships can berth alongside wood jetties which are served with standard gauge railway lines, and both loading and discharge are direct from rail trucks. There is a 5-ton steam crane.

Australia has 21 other lesser ports, but those visited offer a sufficient variety to understand something of the opportunities and problems of Australian Harbour Authorities.

The Philippine Republic has 10 main ports and many lesser ones, but even of these 10 several are considered unsafe for ocean-going ships and are used chiefly for inter-island traffic. Manila and Cebu are the two chief ports, and I visited only Manila which is on the island of Luzon and is, of course, also the capital of the Republic. The berthing facilities are alongside four piers which provide in total berths for 14 deep sea vessels. Cargo is handled by two private stevedoring companies. Discharge and loading are done in the main by ships' derricks, and the layout of sheds and narrow wharf aprons follows the American pattern. There are floating cranes of 25, 60, and 75 ton capacity, and a large assortment of mobile cranes, fork-lift trucks, and other mobile cargo handling plant, mostly left by the U.S.A. Army.

In Japan the Ministry of Transportation is responsible for ports as well as for railways. It has separate bureaux for Construction, Plnnning, Port Facilities, Warehouses, and Machinery. The country is divided into four areas, of which No. 2 covers the ports of Yokohama, Tokyo, and Kawasaki, all of which I visited. The Port and Harbour Bureau of the Ministry is responsible for improvements to the ports, but not for their operation; this is the responsibility of the local or municipal authority such as the Yokohama Port and Harbour Bureau. The local port authority owns the fixed plant, and operates it on behalf of the stevedores to load or discharge ships. Mobile plant, I was told, would be owned by the stevedore, but I saw none.

These three ports are almost contiguous, and may well be merged into one within the next ten years. In all there is a great lack of quay cranes; the American method of discharge by ship's derrick is generally accepted—due possibly to the lack of funds at present to buy quay cranes. But, whereas in the States there exists in every port a vast fleet of mobile cranes, lift trucks, and tractors, in the ports I visited in Japan the mobile plant was lacking even more than the fixed plant. In consequence, I saw a great deal of manual handling such as the stacking of canned goods by hand in sheds, and the manual loading of bagged cement into rail cars. I was told, however, that the average turn-round in Yokohama is only three days, and it handles some twelve million tons of cargo in a year.

Yokohama, which has a splendid harbour, provides deep water berths at buoys, with berths at wharves and jetties for smaller vessels. Some jetties were still leased to the U.S.A. Army at the time of my visit. Several new piers are in course of construction. The wharf aprons on the older piers are extremely narrow—a mere 10-ft. or so—whilst others accord with modern practice. The sheds too vary from the old fashioned ill-lit type with many pillars to the modern sheds with adequate height and maximum floor freedom. There are over one hundred transit sheds and warehouses.

Rail spurs run onto most wharves, and discharge is direct into rail truck wherever possible. The import of coal is by conveyors

Loading packing cases at the Port of Fremantle, Western Australia.

and there are a few cranes for heavy lifts up to 50 tons. In 1954 the port handled approximately 12 million tons of cargo, of which inland and foreign trade were in almost exactly equal proportions. Of the 6 million tons of foreign trade, over 5 millions were import and less than 1 million export, whereas the island trade was evenly divided between export and import. As Japan's exports are increasing rapidly, it is reasonable to suppose that later figures will reveal considerably increased foreign export and hence an increase in total tonnage handled.

Tokyo has 16 deep water berths alongside, and is also very deficient in shore-based cranage. Apart from a 50-ton floating crane, there is scarcely any fixed or mobile cargo handling plant; all vessels are worked by ship's gear and handling on shore is manual. Covered storage space is very limited.

Kawasaki has berths for 18 ocean-going ships at piers and wharves. Coal is handled by conveyors from ship's hold to shore, and there are a few shore-based cranes up to 15 tons capacity.

There are 30 important harbours in Japan, of which the most important in addition to the above are probably Kobe, Osaka, and Nagoya. Conditions are, however, said to be similar to those I saw. A flourishing Port and Harbour Association has a full membership which appears to be ready to emulate the best methods of both the European and American ports as soon as they have the means.

In Japan, therefore, the impression received by the visitor is one of intense industry and great efficiency within the narrow limits set by the lack of modern cargo handling plant. With more cranes—and especially mobile cranes—the turn-round of ships could be yet faster, the tonnage handled greater, and the use of manpower considerably reduced. There is, however, little incentive to reduce manpower because of the ever-present threat of unemployment. A degree of manual cargo handling which would be uneconomic and indeed unthinkable in a Western port may perhaps be inevitable in Japan with its comparatively low labour costs (but not so low as we are inclined to think) and its rigorous control of labour employment.

**Repairs to Ballast Quay at Grimsby Dock.**

In the first major renovation undertaken for some time at the Grimsby Royal Dock a 580-ft. section of the quay is to be rebuilt at a cost of £25,000. The work, which is expected to begin in May, will include the modernisation of the railway sidings, repaving and the provision of a 20-ft. wide roadway to facilitate the handling of cargoes. It is understood that the level of the dock will not be lowered and that no underwater work will be necessary. To enable the berth, which is chiefly used for the handling of timber and bulk cargoes, to remain in service the work will be completed in stages.

# St. Lawrence Seaway and Power Project

## Some Mechanical Design Features of the Power Project

By "ANCAIOS"

It is considered that certain features of the mechanical plant incorporated in the major hydro-electric power installations now under construction on the St. Lawrence river, may find application in normal dock and harbour construction and design. These features will be of interest not only on account of the development of the power project alongside and as part of the Seaway construction, but because of some of their unusual or even unique aspects.

Readers will remember that previous articles appearing in the April, 1955, and October and November, 1956, issues of this Journal, gave some general notes on the Iroquois Dam (which will permit the control of the outflow from Lake Ontario) and the Long Sault Dam in the vicinity of the International Power Station at Barnhart Island. The International Power Station is being constructed jointly by the Ontario Power Commission and the New York Power Authority, and conssits of two structures located to meet at the international boundary. The exterior appearance of both sections of the station have been made identical and although there are variations in the power equipment, the cranes and other servicing equipments are completely interchangeable.

Two totally enclosed 300-ton gantry cranes are to be supplied, one for each power house. The upstream and downstream sides of the cranes are sheathed in aluminium and rolling doors are provided at each end. In common with the gantry cranes at the Long Sault and Iroquois Dams, particular attention has been paid to the appearance, and the architectural treatment given results in the main hoist machinery trolley and the upper girders being completely enclosed. The cranes at the Long Sault Dam, used to handle the 50-ft. wide by 45-ft. high spillway gates, are

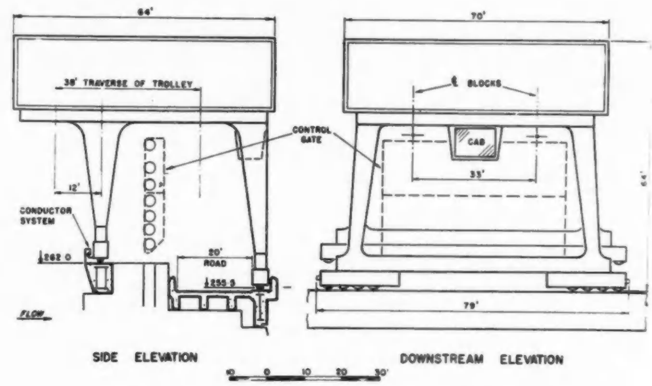



Fig. 1, Long Sault dam 275 ton gantry crane.

illustrated diagrammatically at Fig. 1, while the power station cranes, for servicing the main generators, are shown at Fig. 2. The powerhouse is of the semi-outdoor type and when a crane has been centred over a unit and the generator cover rolled back, the rolling doors referred to above will be lowered to give a weatherproof working space enabling maintenance to be carried out under any climatic conditions. The hoist control of the Canadian crane is arranged for speed limitation varying with load in both the hoisting and lowering motions. The unloaded main hook speed is about 18-ft. per minute compared with 6-ft. per minute if the hook is fully loaded. The controls and drive may be connected to either the main hoist or the travel motors. The auxiliary jibs within the crane are provided with A.C. wound rotor motor drives with normal controls. Due to the size of the power houses a radio communication system is to be installed between the main cab of the gantry cranes and the power house telephone switch boards.

The headgate hoists governing the flow of water to the turbines are designed for a hoisting speed of 5-ft. per minute and a lower-

**Table Giving Hydraulic Gate Data—St. Lawrence Power Project**

| Item | No. | Gate Opening Width | Gate Height | Design Head on Sill (feet) | Gate Weight (lb.) | Downpull from Tests (lb.) | *Type of Wheel | Method of Bearing | Method of *Operation | Lifting Speed (ft. per min.) |
|---|---|---|---|---|---|---|---|---|---|---|
| Iroquois Dam— | | | | | | | | | | |
| Main gates | 32 | 50′-0″ | 48′-0″ | 25 max. differential | 340,000 | 16,000 | Flanged | bronze | Gantry | 7 |
| Steel stoplogs | 6 | 50′-0″ | 8′-0″ | „ | 60,000 | .... | .... | .... | Gantry | 7 |
| Long Sault Dam— | | | | | | | | | | |
| Main gates | 18 | 50′-0″ | 29′-0″ | 29.5 | (See Note[1]) | 10,000 | Flanged | roller | Fixed hoist | 1 |
| Main gates | 13[2] | 50′-0″ | 29′-8″ | 43 | 200,000 | 10,000 | Flanged | roller | Gantry | 2 |
| Gates coupled for diversion | 13 | 50′-0″ | 45′-0″± | 43 | 284,000 | 52,000 | Flanged | roller | Gantry | 2 |
| Diversion port gates | 34 | 16′-0″ | 21′-6″ | 88 | 61,000 | 150,000 | Flanged | roller | Gantry | 2 |
| Massena Intake— | | | | | | | | | | |
| Service gates | 4 | 15′-0″ | 31′-0″ | 85 | 90,000 | 20,000 | Flanged | roller | Fixed hoist | 5 (10 lowering) |
| Emergency gates | 4 | 15′-0″ | 35′-6″ | 85 | 94,000 | 136,000 | Flanged | roller | Fixed hoist | 5 (10 lowering) |
| Steel stoplogs | 8 | 15′-0″ | 6′-0″ | 85 | 11,000 | .... | .... | .... | Operated by mobile crane | |
| Canal Closure Structure— | | | | | | | | | | |
| Steel stoplogs | 1 Set | 50′-0″ | 74′-0″ | 72.5 | 50,000 max. | .... | .... | .... | Operated by mobile crane | |
| Barnhart Island Powerhouse— | | | | | | | | | | |
| Ice chute drum gates | 4 | 75′-0″ | 17′-0″ | 16 | 209,500 | .... | .... | bronze | Hydraulic operation by con- | |
| | 2 | 50′-0″ | 17′-0″ | 16 | 147,500 | .... | .... | bronze | trol floatation chamber pres- | |
| Service frame | 1 | 50′/75′ | 18′-0″ | 17 | 50,000 | .... | .... | .... | sure. Gate designed to be fully opened in not more than 60 sec. | |
| Headgates— | | | | | | | | | | |
| Canadian | 48 | 17′-0″ | 37′-3″ | 96 | 87,500[3] | 238,000 | Plain | bronze | Fixed hoist | 5 (10 lowering) |
| Headgates— | | | | | | | | | | |
| American | 48 | 17′-0″ | 39′-3″ | 97 | 140,000 | .... | Flanged | roller | Fixed hoist | 5 |
| Intake steel stoplogs— | | | | | | | | | | |
| Canadian | 33[4] | 17′-0″ | 8′-6″ | 90.5 | 15,500 | .... | .... | .... | Gantry | 30 |
| American | 6 | 17′-0″ | 8′-2″ | 91 | 19,000 | .... | .... | .... | Gantry | 30 |
| Draught tube gates— | | | | | | | | | | |
| Canadian steel stoplogs | 66[4] | 17′-0″ | 8′-6″ | 90.5 | 15,500 | .... | .... | .... | Gantry | 60 |
| American steel stoplogs | 18 | 17′-0″ | 7′-10″ | 90 | 17,000 | .... | .... | .... | Gantry | 30 |

NOTES: (a) Gates designed for maximum ice load of 10,000 pounds per linear foot extending down four feet from water surface.
(b) Model tests of hydraulic downpull were conducted at the Ontario Hydro Hydraulic Laboratory, Islington, Ontario.

*Type of Wheel F—Double flanged wheel running on a heavy rail
P—Plain wheel running on a planed steel surface

**Type of Bearing, Bronze — Bronze bushing with graphite inserts

[1] Three different types of split gates provided
Top section height varies: 12′-0″, 14′-0″ and 17′-0″
Weight varies 206,000, 216,000 and 200,000 pounds respectively

[2] Includes one extra gate for diversion position — later used a spare gate

[3] 85,000 pounds of concrete ballast extra

[4] Stoplogs are interchangeable between intake and draught tube

*St. Lawrence Seaway—continued*

ing speed of 10-ft. per minute. The gates are lowered under control only of a fan-type brake which restricts the speed of the motor to $2\frac{1}{2}$ times its normal powered speed. During the normal hoisting motion, the fan absorbs only about 5 per cent. of the horse power absorbed when running in the reverse direction at twice the speed. A solenoid-operated holding brake is fitted on the motor shaft, the coil being energised to release. In the event of an emergency involving failure of the normal station service supply, the brake may be released by energising the coil from the station control batteries. It is of course of paramount importance that the headgates can be lowered under any condition whatsoever, be it fire, loss of station service or turbine runaway.

The generators are located at 80-ft. centres, giving a total station length of 3,120-ft. In addition to the 32 generator intakes, there are six ice chute sluices located within the plant. A cross section showing one of these ice sluices and an erection bay is reproduced at Fig. 3, and it will be seen that drum-type gates are provided. The gates will be raised or lowered hydraulically by adjusting the relative positions of two butterfly valves located in the valve chamber at elevation 191, under each gate pocket. One valve admits water at headpond pressure into the chamber under the drum, the other valve controlling the flow from the chamber to the tailrace. The resulting water pressure within the chamber determines the elevation at which the drum gate will remain. Considering the extreme cases, if the outlet valve is closed the gate will rise to its fully closed position, and if the inlet valve is closed with the drain valve opened, the gate will move downward to the fully open position. The control of the gate position will be initiated from a control box located on the headworks deck.

Electric heating of the interior of the drum, the side seal armature plates, and upstream and downstream seals is provided to

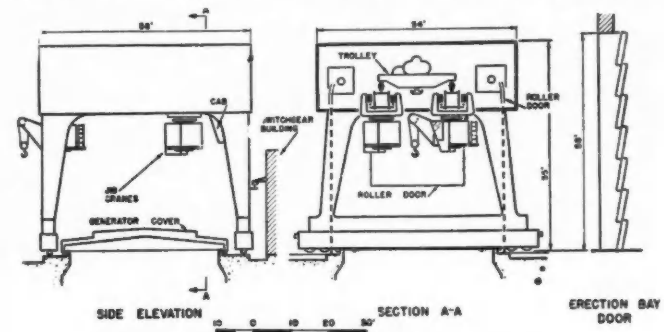



Fig. 2. Canadian powerhouse 300 ton gantry crane.

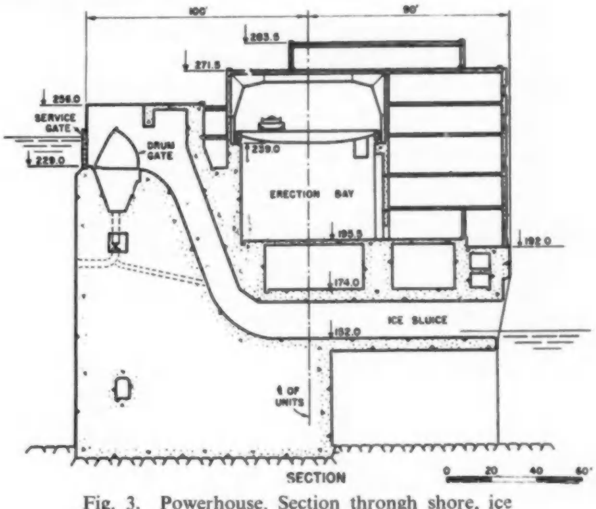



Fig. 3. Powerhouse. Section through shore, ice sluice and erection bay.

prevent the formation of ice on the gate or the surfaces over which the seals pass in operation. Heating of the discharge valve line outfall is also provided. The heaters are controlled from deck level and the heating load for each gate totals about 275 kilowatts.

The decision to install hydraulically-operated drum gates was made only after careful study. It was found that restrictions in space precluded the use of large hoisting machinery, and the space available for the gate itself was very limited. The drum gate has the advantage of forming part of the spillway in its lowered position and this, after modifications in profile determined by model testing, was a final factor in the decision.

It is considered that brief data upon all the hydraulic gates to be incorporated in the St. Lawrence Power Project will be of interest to Dock Undertakings, and by courtesy of the Ontario Power Commission, this information is given in the table on previous page.

**Acknowledgment.**

The information given above is abstracted from a paper entitled "Mechanical Design Features of the St. Lawrence Power Project" read before the Engineering Institute of Canada and due acknowledgment is made to Messrs. Holden and Pemberton-Pigott, the joint authors.

# Annual Report of Chamber of Shipping

## Excerpts of Interest to Dock and Harbour Authorities

In a report running to 189 pages, the Chamber of Shipping review of the past year ranges over a wide selection of subjects. Reference to nuclear power and technical research is made in editorial comment. Below is a summary of the main items of direct interest to dock and harbour authorities.

**Shipping Turn-round.**

Almost complete freedom from dock labour stoppages in the United Kingdom during 1956, and an improvement in the availability of labour, have helped considerably in the turn-round of shipping.

In November the British Transport Commission announced improved arrangements for dealing with export traffic by rail from a number of centres and plans for their extension as soon as possible.

Schemes of staggered loading dates for export cargo, introduced by a number of liner conferences, should further improve the flow of traffic to the ports and, following discussions between the Ports Users' Committee and various road hauliers' associations, better local working arrangements were planned between the road hauliers and principal port authorities for regulating road deliveries.

The need for adequate road access to port areas has been pursued with the Ministry of Transport in relation to the general road programmes of the Government. In consultation with national associations of road hauliers advice was given to the Ministry on the improvements which are likely to yield the greatest benefits.

The investigation of grain discharging carried out by the Shipowners' Ports Committee led to talks with millers and grain importers and subsequently with the Ports Efficiency Committee. Quite apart from the desirability of obtaining a general improvement in the rate of grain discharging in this country, the main objective was to overcome the serious delays experienced at certain ports, notably the Humber and the Clyde. Some progress has been made in the Humber, partly through the employment of additional floating elevators, and a further improvement should follow when the reconstruction of one of the grain discharging berths is completed. In the Clyde, the decision of the Clyde Navigation Trust to embark upon a large scale capital development scheme in connection with their granary and grain-discharging facilities is a particularly welcome development. When the scheme is completed, there should be an appreciable increase in the rate of discharge at that port.

An important factor is the misuse of transit accommodation as storage space. Further progress towards an improvement is unlikely until the grain importers, both merchants and millers, take

## *Chamber of Shipping—continued*

steps to accelerate the clearance of their grain from the transit silos; to keep the port authorities informed of expected arrivals; and, in the case of the millers, to speed up the rate of discharge at their own premises.

**Port Charges.**

The Chamber is dealing with the draft charges scheme, submitted to the Transport Tribunal by the British Transport Commission, in conjunction with the principal national associations of manufacturers and traders through the Traders' Dock and Harbour Co-ordinating Committee.

Under the proposals of the Commission, dues on vessels and merchandise at the great majority of the ports and docks owned by the Commission would be subject to a single schedule of maximum charges for ships and a single schedule of maximum charges for goods. Hitherto the charges at most of the ports now owned by the Commission have been governed by separate schedules which were felt to be appropriate to the trade and characteristics of the individual port. The proposal of single schedules of maximum charges for ships and goods respectively covering some 36 ports introduces an entirely new principle and could lead to a radical adjustment in the **actual** charges to be levied on ship and goods using or passing through certain ports.

The proposals of the Commission require most careful examination and comparison with the detailed schedules of actual and maximum charges which at present apply in the individual ports. It is worthy of note that the schemes together represent a review of a charges structure which has not been the subject of comprehensive examination for almost a hundred years.

**Oil Pollution.**

Last year it was stated that the United Kingdom remained the only country to have accepted the International Convention and to have passed legislation to give effect to it. Since then, Sweden, Mexico, the Federal Republic of Germany, and Denmark have ratified the convention which cannot, however, be brought into force until ten have ratified it, five with at least 500,000 gross tons of tanker tonnage. It is understood, however, that legislative action leading to ratification has been taken in several other countries.

To guide members as to the new liabilities imposed upon them by the Oil in Navigable Waters Act, 1955, the Chamber published an explanatory note and summary of the Act and regulations made under it. Some 4,000 copies of this have been distributed to British ships. Through the ready co-operation of members in the keeping for an experimental period on board ships of oil record books issued by the Chamber, much valuable information was collected. This should prove to be of assistance to the Ministry of Transport and dock and harbour authorities in connection with their plans for the provision of shore reception facilities for oily residues. The oil record book, as modified in the light of knowledge gained from the experiment, is to be issued by the Stationery Office as an official publication. As recommended in the Faulkner Report, there is to be issued a code of conduct in which will be set out the procedure to be adopted for the avoidance of pollution.

**Abnormal Loads by Road.**

The Ministry of Transport's proposals for revising the regulations governing the movement of abnormal indivisible loads and engineering plant by road have not so far been adopted. Some of these loads already move coastwise, but there is little doubt that the roads could be relieved to an even greater extent. For this reason an approach from the Central Electricity Authority to consider in some detail the extent to which coastwise shipping might be used to move pieces of 150 tons and more was welcomed. It is hoped that, as the result of the discussions with the C.E.A., arrangements can be made for the greater use of coastwise shipping, with benefit to all concerned.

**Pilotage.**

At the national level, the talks between the industry and the pilots' organisations, after having been suspended for some time, have recently been resumed with Sir Robert Letch taking the chair in an independent capacity, at the invitation of the Ministry of Transport. Quite apart from the general question of the level of earnings, the Pilotage Committee has had to consider numerous other aspects of pilotage administration.

**Wreck Raising.**

Unlike the majority of Continental ports, most dock authorities in this country have power to claim from shipowners expenses for wreck raising. It is for this reason that the Dock and Harbour Authorities' Association has, for many years, insisted upon a reservation in the limitation of liability convention to exclude wreck liability from the limitation provisions. Discussons with the Dock and Harbour Authorities' Association suggest that an arrangement might be formulated which will enable the association to accept the omission of the reservation from the convention. Two alternative schemes have been proposed. One is that a "wreck fund" should be raised by charging vessels wreck dues. Should a port authority incur wreck-raising expenses (over and above the sum received from the shipowner under the convention) it would be entitled to reimburse itself from the " wreck fund." The other proposal considered is that ports should enter into a " block insurance " scheme to cover excess wreck-raising expenses. Here again dues would be levied on ships to provide finance for payment of insurance premiums.

**Clean Air Act, 1956.**

There have still to be made regulations exempting from the penalty provisions of the Act emissions for specified maximum periods, although discussions have taken place with the Ministry of Transport on the need to provide in the regulations for special exemptions for shipping according to circumstances and the nature of a ship's firing arrangements. The industry has submitted nominations for membership of the Clean Air Council, which is in process of being set up under the provisions of the Act.

**British Transport Commission Act, 1956.**

The Bill dealt, among other things, with plans for extending the oil jetties at Saltend in the Humber, an improved facility badly needed by oil tankers. This provision was welcomed, but the commission also sought authority to charge the foreign-going rate of dues on tankers exceeding 2,500 g.r.t. discharging at the Saltend jetties or at the eastern jetty, Immingham, and on their cargoes. This departure from the established principle of charging a lower rate of dues on coastwise vessels and cargoes regardless of size was unacceptable to the industry. The commission withdrew the proposal on the conclusion of an agreement with the oil companies concerned under which those companies will assist in financing the new works. The commission also gave an assurance that in any charges scheme relating to port facilities it would not limit the application of any lower coastal rates to vessels of any specified tonnage. This applies also to cargoes. After consultation with coasting owners it was decided not to oppose the commission's proposals to fix permanently the swing bridge at Naburn.

**Manchester Ship Canal Act, 1956.**

In the Bill promoted by the Manchester Ship Canal Company it was proposed to extend the powers of the harbour master to enable him (i) to prohibit tankers entering the canal except for loading, discharging or bunkering; (ii) to limit the period for which any vessels might remain at a berth for purposes other than loading, discharging or bunkering; and (ii) to sink or flood any vessel on fire or on which there had been a fire.

The Chamber, supported by the Dry Dock Owners' and Repairers' Central Council, submitted that, if these powers were necessary at all, they were unreasonably wide. The canal company eventually agreed to amend its Bill by confining the powers of the harbour master to refusing entry to a tanker if the sole purpose of entry is for tank cleaning. After consultation with tanker owners, it was agreed that the special circumstances in Manchester justified this power, but it was made clear to the promoters that the Chamber would not accept it as a precedent for adoption in other ports.

# Bulk Handling of Coal in the U.S.A.

## Review of Modern Water-Borne Systems

By J. T. CRAWFORD, E.M., M.Am.I.M.M.E., M.S.Am.M.E.*

THE variety of methods and equipment used for handling coal after it has been mined, prepared and loaded for primary shipment by the producers is, in the United States, so great that any attempt to present a clear and simple picture immediately becomes bogged down in a mass of detail. In dealing with the movement from the production areas by railroad car, barge and truck to tidewater, lake, river and rail serviced areas, it is necessary to take into account the myriad ideas developed by not only the companies that handle coal for distribution, but by the consumers as well; and while coal is coal, there seem to be innumerable kinds of innumerable sizes, many of which are of varied size consists. When all of these are stacked together, the end result is a variety of equipment and handling methods that staggers the imagination.

With few exceptions any materials handling equipment system capable of economically transporting, screening or storing coal will also handle any other bulk material of approximately the same size consist for which the coal system was designed, but at less cost and at a higher rate of capacity. Coal is as abrasive as many bulk materials and can be as "sticky" as many more, but in addition it has the undesirable physical property of low specific gravity. As a result, all coal handling, preparation and storage facilities are initially confronted with the problem of bulk and it is surprising how often in design this factor is apparently forgotten, overlooked or neglected. For example, a conveyor belt capable of transporting 1,000 t.p.h. of coal could readily handle 3,000 t.p.h. of iron ore by amplifying the drive machinery, the power and the belt specifications. No space increase is required. A clamshell capable of picking up 19 tons of coal would hold 55 tons of iron ore, etc. This item of low specific gravity as translated into bulk oftimes places restrictory (and detrimental) limits on coal handling equipment of all kinds.

The volume of coal moved from the mines in the United States in the year 1956 exceeded 500,000,000 tons. This amount was produced from some 6,000 mines located in 27 states. Of this total production about 79 per cent. was transported in railroad cars; about 10 per cent. was loaded into barges for river transportation; and about 10 per cent. was hauled by truck. It is estimated that 0.2 per cent. was pumped by pipeline. Of the coal initially loaded into railroad cars at the mines an estimated 30 per cent. eventually ends its journey via barge, lake freighters or salt water cargo vessels. For example, shipments of coal by barge in the ports of New York, Philadelphia, Baltimore and Chicago will approximate 30,000,000 tons annually. Shipments in bulk freighters plying the Great Lakes will exceed 50,000,000 tons annually.

In the transfer of coal from railroad cars to vessels at tidewater or lake, the great bulk of the tonnage to-day is by two methods; first, by an elevating railroad car dumper which is either a straight, vertical lift, or a combination of incline plus vertical lift, followed by turning the car almost upside down, into large chutes, equipped with a telescoping and trimming device for distributing coal into the holds of boats with as little breakage as possible. Such devices have capacities up to a maximum of about 3,500 tons per hour, although this may be exceeded under exceptional conditions. The second and increasingly more popular method is to empty railroad cars into an under-track hopper and thence to a belt conveyor or series of belt conveyors that elevate the coal to a shuttle belt conveyor that in turn by elevating, lowering, advancing or re-tracting can distribute the coal into the vessels holds. In some instances, the belt conveyor merely delivers the coal to a telescoping trimmer which in turn distributes the coal into the vessels holds with somewhat less breakage than is the case where the belt conveyor alone does the actual loading of the vessel. Installations of this sort generally have a capacity not exceeding 2,000 tons per hour, although in some instances, it may run up to 2,500 tons per hour.

Regardless of which method of loading is used the point of initial interest is the railroad yards near the loading docks. Here the freight cars, of 50 to 70 ton capacity, are classified according to consignments. The loaded cars, at a rate exceeding 6 cars per minute, are classified over a "hump"—that portion of the yard elevated above the tracks connected with it—so that the cars shoved over it roll by gravity onto one of 60 to 80 classification tracks which vary from 25 to 125 cars in capacity length. Classification is controlled electrically (push-button controls) by an operator in one of several towers overlooking the yards. Each operator receives a list of incoming cars and the classification designation of each to guide him in processing the cars. As a car moves over the "hump" its speed is controlled by car retarders, operated from the towers. Switches at the far end of the "hump" route the car onto the proper track. Switches are operated from the towers by air or electricity. After classification, cars are moved to storage yards pending arrival of the vessel for which they are intended. The Walbridge Classification Yard near Toledo, Ohio, contains 117 miles of track for 5,000 cars and the Presque Isle Storage Yards nearby have 75 miles of track accommodating 4,000 cars.

On arrival of a boat the cars containing its cargo move to a car dumper approximately 115-ft. high, which can handle cars up to 60-ft. long and up to 13-ft. high at a rate of 50 cars per hour. Cars are moved along the pier tracks by electrically operated car pushers capable of handling 25 cars on four tracks in one operation. At a point short of the dumper, the tracks converge into a single track, at which point a haulage car takes over. An opening in the tracks permits the haulage car (usually called a "barney pig") to pass under the first car, come up behind it and move it from the level stretch of track, up an incline to the cradle of the dumper. The cradle is equipped with retarders that squeeze the flanges of the car wheel, holding it in place. The cradle with the loaded car moves upward after a steel curtain is fitted over the car. About half-way up the dumper, the cradle is stopped and rolled over on its side dumping the coal through the controlled opening in the curtain into a pan which holds 120 tons of coal and leads into a telescopic chute which reaches into the hold of the boat being loaded. The combination of the curtain, pan and telescopic chute plus a trimmer at the lower end of the chute, controls the flow of coal from the pan into the hold of the ship with a minimum amount of breakage. Dust is controlled during the dumping operation by spraying water containing carefully controlled amounts of any one of several chemical wetting agents. After emptying, the car is righted, lowered on the cradle and bumped from the dumper by the following car. The empty car rolls down a sharp incline and its momentum carries it up another inclined section of track known as the "kick back." As it rolls down the "kick back" it is automatically switched on one of the tracks used for gathering empty cars.

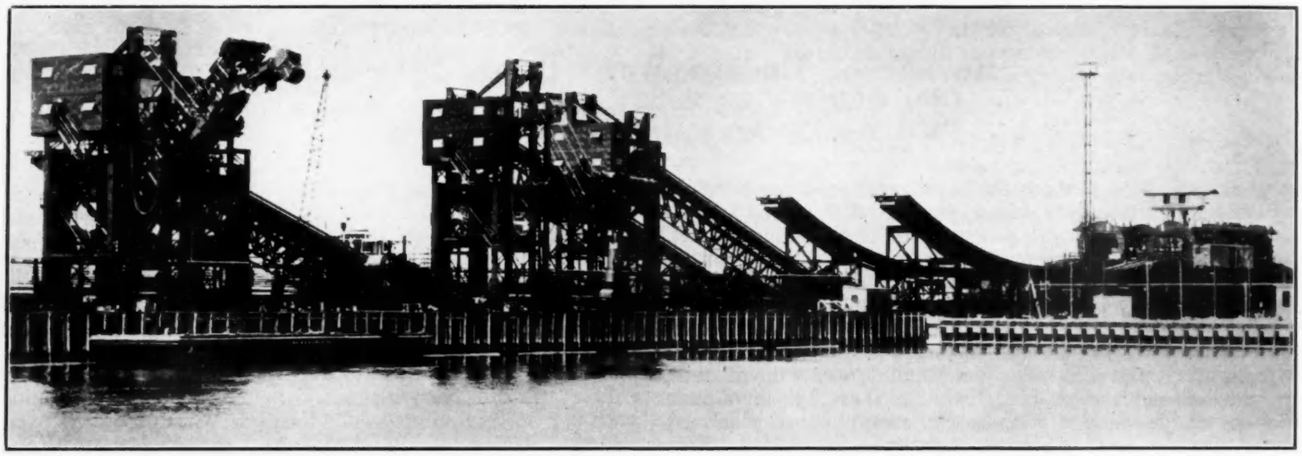
Practically all of the equipment of any size, described above, is owned and operated by the various railroad companies, and in a few instances, by groups of producing companies. Such equipment on tideway is located principally at Norfolk and Hampton Roads, Virginia; Baltimore, Maryland; Philadelphia, Pennsylvania; and on the Great Lakes, at Buffalo, Erie, Sandusky, Ashtabula, Lorain, Cleveland, Toledo and Chicago.

Vessels currently in the bulk freight trade on the Great Lakes range in capacity from 5,000 to 22,000 tons and up to 24-ft. draft. The latest one to be built will be 729-ft. long, have a beam of 75-ft. with a moulded depth of 39-ft. This will be a conventional, straight-deck type of bulk freighter—not the self-unloader type. Power will be from coal-fired boilers furnishing steam to a 7,500 shaft horse power turbine designed to propel the vessel at about 16 miles per hour.

Where daily tonnages do not justify the capital expenditures

* Vice-President—Operations—North Western-Hanna Fuel Company, Superior, Wisconsin.

*Bulk Handling of Coal—continued*



Four separate 60-in. belt conveyor systems handle 6,000 t.p.h. into four ships simultaneously—Newport News, Virginia.

necessary to install rotary dumps for railroad cars, the saddle type of car shaker is generally satisfactory. When these are used, the hopper or battleship type of car is dumped by opening the bottom of the railroad car and the car shaker vibrator, which has been placed astride the top of the car sides by a crane or other means, vibrates the contents from the car. Strong, well-built cars are desirable to insure the removal of the contents before the rivets holding the car together let go first.

Loading of river barges is, with few exceptions, accomplished with belt conveyors. Where the tonnage is not sufficient to justify a fixed loading plant, the loading may be readily handled by crawler crane and clamshell.

The principal design factor to be considered in river barge loading or unloading is the variable river stage which in some instances may amount to a 60-ft. change in elevation.

A fixed loading plant may start with either a rotary dump or a single or double track hopper into which the coal falls by gravity. From the hopper under the track coal is generally fed by a reciprocating or vibrating feeder to a belt conveyor. In order to take care of the various river levels the first conveyor after the feeder is arranged with a bend pulley at approximately track elevation which permits raising or lowering the discharge end to suit the river stage. A hoist tower straddling the belt conveyor at the discharge end of the first conveyor contains an electric hoist placed well above maximum flood water elevation. The hoist can thus raise the discharge end of the first conveyor and the feed end of the second conveyor when the second conveyor is retracted under the first. Retraction here is taken care of by having the feed end of the second conveyor carried on a wheeled framework which rolls on rail underneath the outer half of the first conveyor. A third conveyor is carried in a horizontal position on a floating spar barge which serves as the loading dock for the river barges. The discharge end of the second conveyor rests "piggy back fashion" on the third conveyor and discharges onto it. This sort of arrangement requires accurate alignment of the spar barge. The spar barge, the third belt conveyor and the discharge end of the second conveyor rise and fall with the river. As the spar barge rises with the water it can be pulled shoreward with the second conveyor moving up its track on the river bank. At extreme high water, the second conveyor can be detached from the third conveyor on the spar barge, suspended from the first conveyor and hoisted along with the first conveyor. At this stage, the first conveyor would discharge directly onto the third conveyor on the spar barge and the second conveyor would be in effect stored longitudinally under the first conveyor.

Unloading of river barges, either at consuming plants or commercial or municipal docks, may be accomplished in a few instances by an elevator leg, but most of the tonnage is unloaded by clam shell. There are 3 elevator leg installations in the Pittsburgh area which unload coal from barges at approximately 2,000 t.p.h.

River coal barges are of steel and of welded construction. Typical dimensions are 195-ft. long, 35-ft. wide, 11-ft. depth, capacity 1,425 tons. Many of these are now being built with sectional covers so that grain can be hauled on the return trip. Recent tow boats are up to 200-ft. long, 45-ft. wide and 12-ft. deep and are equipped with two diesel engines developing 4,200 horsepower. Twin propellers are 10-ft. in diameter, 5 bladed and are housed in specially designed Kort nozzles. Steering is by means of a single rudder aft of each propeller. Forward of each propeller are two flanking rudders.

Clam shell unloading of barges in some instances is done by unloading towers which may be stationary or mobile on tracks and generally consists of steel framework which carries an elevated runway track, occupied by a man trolley or rope trolley which handles the clam shell and its associated drums and cables. Coal unloaded by the clam shell may be deposited on the dock in back of the unloading tower for subsequent re-handling, or may be dropped into bins from which either belt conveyors, trucks or bulk movers may distribute the coal to storage points or railroad cars. Many recent installations at barge unloading points have been of this type, but many of the barge unloading terminals are serviced by whirlies or the usual type of crawler cranes. For unloading barges, few clam shells will exceed five ton capacities, with most of them averaging around 2½ to 3 tons capacity.

Unloading of vessels on salt water or on the Great Lakes may be divided into four main methods: the normal type of travelling bridge crane; loading towers similar to one end of a bridge; whirlies or crawler cranes equipped with elevated operator's cabs; and by self-unloading vessels. On the Great Lakes, self-unloading vessels deliver mainly to Canadian points and to locations on the American side as far as the west bank of Lake Michigan. Some self-unloading coal enters Lake Superior, with coal for the mining companies of the Michigan Upper Peninsula and for the new iron ore concentrators on the north shore of Lake Superior. For docks equipped with whirlies, or whirler cranes, such equipment is generally on elevated tracks so that the operator may see down into the vessel-hold while unloading and so that coal can be stocked in a reasonably high pile. Where the unloading is by crawler crane, the elevator's cab is frequently raised above the normal level so that the crane operator can at least see over the top of the vessel's rail, but generally does not have a view down inside the hold.

Unloading towers are gaining rapidly in popularity for most kinds of bulk freight. In iron ore, they offer advantages over the Hulett type of unloader and it is expected will gradually replace them. Their use for unloading coal is indicated in harbour areas where space is not at a premium for storage of coal or where coal varieties on one dock will permit of stocking by belt conveyor. Tower unloaders cannot be used for reclaiming nor can they be used for distributing to the storage area. This type of unloader utilises man trolley and clamshell and, like travelling

## *Bulk Handling of Coal—continued*

crane bridges, are of open steel work construction. A typical one has a 165-ft. trolley runway supported by a 70-ft. high tower, 31-ft. long and 35-ft. wide, which travels along the dock on two single rail tracks spaced on 31-ft. centres. The clam shell carried by and operated from the trolley delivers to a hopper in the rear side of the tower from whence the coal is discharged onto a 60-in. belt conveyor. Unloading rates up to 1,500 tons per hour are common with this sort of equipment. A 67-ft. hinged apron section forms part of the runway on the water side. The apron is supported by a mast extending 30-ft. above the towers. A set of linked eyebars runs between the top of the mast and the outer end of the apron, with a set of lifting falls provided to raise the apron nearly vertical to clear ship's rigging. The apron hoist unit and electrical equipment for controlling tower travel motors are housed in the top of the tower. The trolley carries its own operating equipment and controls in a cab beneath one end of the main trolley frame. The operator's cab is suspended beneath the control cab and provides maximum visibility. Considerable weight savings on these man trolleys can be had by the use of edge or flat wound resistances and with force blown ventilation motors. Buffers of either spring or hydraulic type are installed at each end of the trolley runway and are capable of absorbing the energy of the loaded trolley at full speed. When the apron is raised the trolley is protected from over-shooting the water end of the runway by a simple mechanical spring buffer barricade which drops into place automatically as the apron is raised.

Where the storage layout permits, the use of a tower unloader followed by a belt conveyor delivering to a stacking conveyor offers many advantages. Design and development of self-propelled stacking conveyors has reached the point where the latest one has a 275-ft. boom radius. Its overall length from the tip of the boom to the end of the counterweighted boom is 416-ft. It will build a stockpile 90-ft. high. Here again, however, we run up against the fact that this is one-way equipment, in that it cannot be used to reclaim.

Most tonnage at both consumer and commercial docks on the lakes is unloaded by travelling bridge cranes of both the man-trolley and the rope-trolley type, with the majority being of the man-trolley type. Such bridges will handle clam shells having a capacity of from 5 to 19 tons. Runways for the travelling bridges themselves vary from a length of 800-ft. to as much as 2,900-ft., and the depth of the dock covered by the bridge span, from 200-ft. to 550-ft. When the length of the trolley unloading apron or boom and cantilever is added to the bridge span, the trolley travel in some instances may run up to as much as 700-ft., although such lengths are generally conceded to be uneconomical. Unloading capacity on such docks, depending upon the number of bridges available and the type of coal unloaded, will vary between 300 and 700 tons per hour, with a few presently-building unloading towers designed for industrial and process coal only, that are expected to have unloading rates of around 2,000 tons per hour.

All of the travelling bridge cranes have the advantage that they are also used as reclaiming devices and may be used for transferring coal from dock storage into bins for truck loading; to conveyor belts for transfer to loading points; and for railroad car loading. Many of these bridges are of such size that complete screening and oil-treating equipment is included in one or both of the bridge legs, and where this is done, coal is often screened into four or five sizes before re-shipment. In addition to being able to load either screenings or sized coal into open railroad cars, many of the bridges are equipped to load either screenings or various sizes into box cars. In all instances, such screens are of the conventional shaker or vibrating type. Even on the commercial docks where as many as 30 or 40 kinds and sizes of coal may be handled throughout the course of the year, reloading capacity may run to as much as 5,000 tons per day, and on industrial coal, rates up to 1,200 tons per hour are not unusual. Loading capacities at these docks depend more upon railroad car supply and switching facilities than on any other factor.

At docks where a variety of kinds and sizes of coal must be handled and stored, it is noteworthy that the basic design of the travelling bridge cranes has improved so little in the past 40 years. The only consequential changes that have been made are in the detail of the bridges with a view toward easier maintenance requirements and standardisation of moving mechanisms, plus some little increase in capacity. Many of the older bridges have been modernised, particularly with lighter weight electrical control equipment and motors, to the point where their capacity is more than some of the bridges that have been erected in the past five years. From the viewpoint of direct cost, it might be said that the only real improvement in the past 40 years in this type of equipment, has been in maintenance cost alone; and in a good many instances, the higher depreciation cost of the new bridges more than offsets the decreased maintenance costs over the older structures.

Noteworthy advances in clamshell design and material have been made. What are believed to be the largest clamshells in the world are being used to handle coal at Sparrows Point, Maryland, and in the harbours at Superior, Wisconsin and Duluth, Minnesota at the western end of Lake Superior. Larger clam buckets could be built but there would be little use for them, since radical changes in naval architecture would be necessary to accommodate clams larger than the 22 cu. yd. (19 ton coal capacity) buckets now in use. Many of the clamshells used have been limited to a 6½-ft.

(Left). Stationary unloading tower, 42-in. belt conveyor, 800 t.p.h. Chicago, Illinois. (Centre). Car dumper and loading equipment discharging into lake freighter at Sandusky, Ohio. (Right). This dock at Newport News, Virginia, dumps 6,000 tons per hour into four ships simultaneously.

## *Bulk Handling of Coal—continued*

width to provide ready entry into the 8-ft. wide hatches which were so prevalent. Most of the freighters plying the Great Lakes now have 9-ft. hatches so that 7½-ft. width clams are now common. Clams with a width of 6½-ft. having a capacity more than about 12 tons of bituminous coal are not economically feasible since at about that capacity the ratio of opened length to free inside width becomes too great, and the clams will not dig properly nor fill to capacity. One major asset of the 7½-ft. width, as compared with the 6½-ft. width, is the very materially reduced crushing which ensues. The one big disadvantage of the lightweight clams is that they will not dig satisfactorily nor fill to capacity in sized coal larger than Stove (1¼-in. x 2½-in.). Their use in Egg size (3-in. x 5-in.) or Block (plus 5-in.) is generally unsatisfactory. In handling these sizes there is simply no substitute for weight. However, the Egg and Block size tonnage is so small compared with industrial tonnages under 3-in. size that little consideration need be given to the lessened capacity when handling the large sizes. In the Stoker and industrial sizes (passing through a 2½-in. screen), the digging action of the clam depends more on the curve of the shell rather than upon the weight, although excessive weight can make up for poor design when handling the smaller sizes of coal.

The shape or curve of the back plate is as important for maintenance as it is for effective digging. It is not uncommon in these lightweight clams to have the ⅜-in. to ½-in. thick aluminium sides and back of the lightweight clams last in excess of 10 years, during which time the clam may handle some 5 to 10 million tons. Lightweight design and material have changed former clam weight to pay load ratios of 1.25 : 1 to present ratios of 1 to 1.25. By the use of such clamshells which reversed the dead weight to pay weight ratio, the capacity of the bridges in unloading or reloading has been increased considerably without increasing the weight on bridge spans or requiring larger h.p. motors.

The subject of clean-up clams is frequently controversial and it is not proposed to expound upon the matter here. Suffice it to say that where trolley turntables, rotating rings or other devices are available for rotating the clams and where auxiliary equipment such as pneumatic tyred scoop bucket tractors can be placed in the hold to feed the digging clams during the clean-up period of vessel unloading, there seems to be little justification for equipment such as clean-up clams which have such excessive weight, low capacity and a limited use for other phases of any operation.

In addition to reclaiming coal from the dock storage areas by the unloading equipment, some older docks, as well as some of the newer docks, have installed tunnels underneath the dock floor so that reclaiming can be done by belt conveyor. In some instances these conveyors may run up to a length of 1,800-ft. between head and tail pulley. Frequently the belts deliver to large screening plants on elevated structures, the bottom of which consists of a series of bins, which enable the plants to hold up to 32 kinds and sizes of coal. From such screening plants coal may be loaded either into railroad cars or trucks. The greatest concentration of such commercial docks and screening plants is located at Duluth-Superior at the western end of Lake Superior, and from Milwaukee, Wisconsin north to Escanaba, Michigan on the western bank of Lake Michigan.

Handling system utilising tower-unloader, 42-in. belt conveyors and travelling revolving stacker, 650 t.p.h. Depot Harbour, Ontario, Canada.

320-ft. span travelling bridge crane, with 19 ton capacity clam shell, unloading standard Great Lakes bulk freighter. Superior-Duluth Harbour at western end of Lake Superior.

Here it is time to mention that it is considerably easier to dream up a handling equipment project for, say, 500,000 tons per year than it is for 100,000 tons per year. Unfortunately, for the economics of the situation, a handling equipment layout frequently requires hourly or daily rates that may be 5 to 15 times as much as the average daily rate based on the annual tonnage, and as a result many layouts are under-designed and over-loaded or end up by being over expensive on fixed costs.

The newest vessel bunkering dock on the Great Lakes inland waterway, soon to be a Seaway, is a good example of small annual but large peak handling design. This dock is located on Lime Island, Michigan, in the St. Mary's River between Lake Huron and Lake Superior, about 100 yards off the vessel channel. Annual tonnage on coal seldom exceeds 150,000 tons, but the daily tonnage may be as high as 2,000 tons, and bunkering is done at a rate of 800 tons per hour. Each bunkering may vary from a low of 35 tons to a high of 400 tons. This plant also bunkers No. 6 Residual (Bunker "C") Oil as fast as vessel tanks can receive it up to 1,800 gallons per minute. Coal from the storage area is transferred into four 100 ton capacity steel bins, erected in pairs, by a crawler crane and clamshell bucket. Reciprocating feeders under each pair of bins deliver coal at 800 t.p.h. to a 42-in. belt conveyor (No. 1) travelling at 450 f.p.m. This No. 1 belt conveyor is 400-ft. between centres, being level underneath the bins and then rising at 17 degrees to the discharge end. The discharge chute from the second feeder to this belt is hinged and counterweighted in such a manner that when the feeder is not delivering coal, it automatically raises to give sufficient clearance for coal delivered to the belt from No. 1 feeder (nearest to tail pulley). Coal on the incline of No. 1 belt conveyor is weighted automatically by a belt scale which totalises all coal tonnage passing that point and also registers the weight of each separate fuelling in the control house near the top of the loading tower. No. 1 belt conveyor delivers, via a transfer point to No. 2 belt conveyor, which changes the direction of flow 90 degrees and carries the coal from the transfer tower to the loading tower located at the channel edge of the dock. No. 2 belt conveyor is hinged at the transfer point and the discharge or head pulley end rides in a vertical slot between the steel framework of the loading tower. This permits a vertical range of discharge over the head pulley of about 22-ft. which, with its connecting chutes, enables fuelling of bunkers at any height likely to be encountered on the Lakes or the future Seaway. For any given fuelling, the conveyor inclination may range from a minus 3 degrees to plus 15 degrees with the hori-

## Bulk Handling of Coal—*continued*

zontal. A hinged steel chute, mounted on the head pulley shaft, carries an extension consisting of a telescopic section 22-ft. long, which gives a combined chute length capable of being varied from 32-ft. to 50-ft., thus enabling trimming of the fuel in any vessel bunkers. All fuelling is controlled by the loading tower operator from his enclosed control room located 60-ft. above water level at the edge of the dock from where he has an excellent view of the vessel and most of the bunkering plant. In actual fuelling, the operator is apt to be concurrently raising or lowering the discharge end of the No. 2 belt conveyors, lowering or raising the main chute and extending or retracting the telescopic section. This modern coal and oil bunkering plant provides a combination of the fastest and most readily accessible fuelling facilities on the Great Lakes.

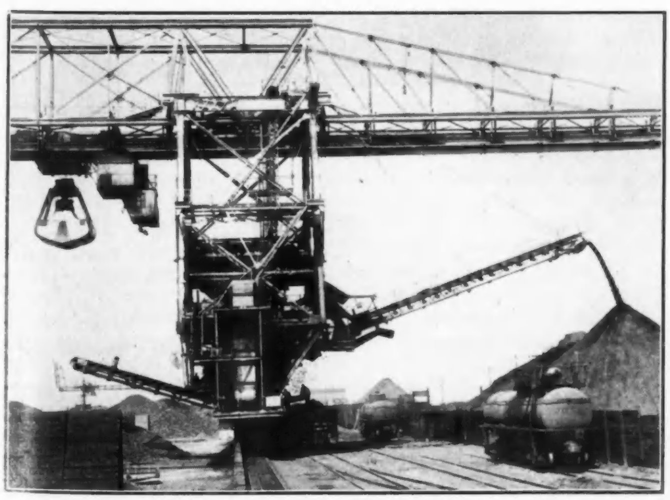
The usual type of belt, flight and pan conveyors, as well as chain bucket and belt bucket elevators, are in evidence anywhere that coal is handled. This standard equipment has changed very little in the last 25 years, except in details, which include:—

(a) Anti-friction bearings replacing sleeve bearings
(b) Use of impact absorption rollers at loading points on belt conveyors
(c) More effective use of training idlers on belt conveyors
(d) Use of self-cleaning return idlers on belt conveyors
(e) Application of fluid couplings on conveyor drives. Much too little use is being made of these for conveying problems.

In many storage areas, where coal is stored in a common pile, excellent use is made of slackline draglines for both stocking out and reclaiming. These are generally of the Sauerman type, with the crescent-shaped scraper bucket operated by slack cable from either fixed or movable anchor points.

For very large areas and particularly where packing of the coal to avoid spontaneous combustion is desired, the use of bulldozers and carry-alls or self-propelled carry-alls has progressed rapidly in the last 10 years. This method, used for both stocking out, packing and reclaiming, is particularly applicable for use at utility plants where either few or many varieties are stored in common pile. This method cannot be used economically on commercial docks, but at utility plants it is not unusual to have four of the large self-propelled "pan scrapers" stock, compact and reclaim 850,000 tons annually after the coal has been unloaded. This method has the advantage of compacting simultaneously with storage and in such layouts heating of the storage piles is unheard of.

During the past few years, there has been wide acceptance of the four-wheeled pneumatic-tyred tractor equipped with a front end loader or bucket. These come in several sizes, either two or four-wheeled drive, and in handling coal use a bucket much larger than the conventional gravel or clay bucket. These are presently in use at some commercial docks where they are used to clean up in the hold of vessels; to handle snow during the winter; to clean up dock areas and re-pile small tonnages so that larger reclaiming equipment can work more efficiently; to pack smaller piles of coal of less than 100,000 tons; to transport equipment; and to some extent lend their use in loading occasional trucks. So much use is made of these machines that most operators can not now understand how they were able to get along without them ten years ago.



Screening plant in pier leg of bridge. Clam weights 24,000 pounds, picks up 29,000 pounds. This is the largest coal dock in the world, 3,200-ft. long x 570-ft. wide, plus a 150-ft. wide vessel slip. Handles 36 different varieties of coal. Can readily load on commercial basis at rate of 5,000 tons per day. Superior, Wisconsin.

Conveyor system with stationary telescopic stacker, delivering to pan scrapers for packed storage. Joliet, Illinois. Typical storage for large electric utilities.

The most recent innovation seems to be the hydraulic transport of coal slurry in pipe lines. This is now past the experimental and construction stage and entering the operational period. The most noteworthy of these is the 110 mile pipe line from Cadiz, Ohio to Cleveland. This line is of 10-in. pipe, laid 4-ft. underground, handling 150 t.p.h. of fine coal slurry at 50 per cent. solids by weight and 950 p.s.i. station pressure at velocity of about $3\frac{1}{2}$ m.p.h. The coal will thus require about 30 hours for the trip and will use 36,000 gallons per hour of water for the vehicle. Three pumping stations are about 35 miles apart. Coal under $\frac{1}{8}$-in. in size is transported from the mine preparation plant at Cadiz to Cleveland, is then filtered and dried and is used by an electric utility under its boilers. This method on this location is less costly than rail transportation. Its field, however, would appear to be limited to a relatively few specific areas of the country.

The only other hydraulic transportation of coal, or what might better be termed a distant relative of coal, noteworthy of attention in the United States at the present time is the 70 mile pipe across some of the most rugged terrain in the Rocky Mountains. This line, now under construction, will carry gilsonite ore between Bonanza, Utah and Gilsonite, Colorado, where it will be converted into coke, gasoline and fuel oil. This will be a 6-in. underground line. Velocities will range between 200 and 500 g.p.m. at a pressure of 2,200 p.s.i. The Gilsonite slurry will range between 20 and 60 per cent. solids.

Belt conveyor use continues to grow in popularity with each passing year and for good reasons. Applications are made for almost any distance of a few feet, or, as in the case of the proposed River-to-Lake Belt Conveyor Company, may be for hundreds of miles. More and more instances are noted of the use of belt conveyors from mines or preparation plant direct to consuming facilities located nearby, such as that of the Ohio Public Service Company and that of the Mathies cleaning plant to the Mitchell Power Station of the Duquesne Light Company, near Pittsburgh, Pa. Increasing use of impact idlers, training idlers and self-cleaning return idlers, has solved many difficult operating problems. The proven method of flipping the belt over after leaving the head pulley so that the load side of the belt is uppermost on the return side, has been of great help in handling wet, sticky material. The present successful method was developed by

*Bulk Handling of Coal—continued*

the National Iron Company in Duluth for the handling of sticky iron ore on the Mesabi Range.

In addition to the large belt installations handling large tonnages, we also find many applications of small, portable belt conveyors in the 8-in. wide by 10 or 12-ft. long range, rated at 1 or 2 tons per minute, and used to deliver coal from truck to consumers' bins. These are driven by small gasoline or electric motors, by direct power take-off from the trucks or by hydraulic motors.

In conclusion, I submit that bulk material handling systems are as fascinating as they are frustrating; that they are limited only by the economics of each particular location and by the designer's and operator's ingenuity; that they will vary as much as and in conformity with the personnel in each owning or operating company; and, finally, that there is no end to the variety presently being used or on the drafting tables at the moment.

# Improving Organisation of Work and Output in Ports

" A long line of ships is anchored outside the harbour for days, each ship idly awaiting its turn to berth: that is an all too familiar scene in many ports in the world. When this occurs, the ship is idle while its overhead expenses, including the wages and maintenance costs of the crew and the interest on capital invested, keep mounting up, the delivery of goods is delayed, the goods themselves are even sometimes diverted, freight rates increase and trade is hampered."

This brief description of the state of affairs at present prevailing in many parts of the world is to be found in a report prepared by the secretariat of the International Labour Organisation for the Sixth Session of the ILO Inland Transport Committee which is being held in Hamburg from March 11th to 23rd.

On the basis of this report government, employer and worker representatives from the 26 ILO member states participating in the meeting will study one of the items on the agenda, namely, the methods of improving organisation of work and output in ports.

**Slow Turn-Round of Ships.**

The report deals in the first place with the turn-round of ships in port in relation to the measure of productivity of ships on the one hand, and output of dock workers on the other.

From an extensive analysis made by the ILO of documentation available from various countries, it would appear that the present turn-round of ships in ports is in fact slower than that obtaining in the years preceding World War II, despite an improved post-war fleet with ships of greater speed and superior handling gear.

The report points out that the experience of liners operating from the United Kingdom to Australia shows that before the war a vessel used to do five round voyages in two years. Five voyages on the same route completed in 1950 took three years and ten days, which is a year and ten days over the pre-war average.

A cargo liner company in trade between the United Kingdom and India, Pakistan and Ceylon reported a drop from three voyages a year per ship before the war, to a little less than two voyages in 1955.

Still further examples of delay incurred in the turn-round of ships are given in the report.

**Causes of Delay.**

Delays stem from a variety of factors, many of which are of a commercial, technical and administrative order not falling within the competence of the ILO. As " any factors can lead to port congestion, to place the blame mainly on the workers—a tendency not infrequently noted—may be very misleading and unfair."

Brief mention is made of only a few of these factors:

1. Concentration of shipping on a smaller number of ports;
2. War damage has not yet been completely repaired at a number of ports;
3. Tendency to use larger ships;
4. Failure of the different services involved to co-ordinate their time-tables and their efforts.

**Relations Between Management and Labour.**

However, in view of the I.L.O's special concern with labour, the report is mainly devoted to the study of this problem and the organisation of work. It notes that port congestion quite frequently occurs " because of industrial disputes affecting port workers, and on other occasions because of the relatively low productivity of labour in handling the goods."

Because of the repercussions which industrial disputes bring in their train, the report underlines the importance of labour-management relations and stresses the need to seek suitable methods of improving such relations. " The dockers often fear that the introduction of new mechanical equipment or methods of work will increase unemployment or under-employment among them, and sometimes require of them a physical effort exceeding their capacity or prejudicial to their health and safety and until the dockers' fears are overcome as a result of assurances by employers and favourable experience, it may prove difficult to secure their co-operation in the adoption of new methods and in the increasing of output." If the relations between management and labour " are based on active co-operation and mutual trust between the authorities and employers concerned on the one hand, and the workers and their trade unions on the other, a great contribution can be made to a programme designed to improve output in ports."

To promote sound labour-management relations, the report outlines possible measures such as the creation of work councils or joint bodies to consider improved methods of work and organisation in ports, and focuses attention on the importance of methods of prompt, on-the-spot adjustment of disputes or grievances relating to certain particular aspects of conditions of work.

The creation of good systems of communication between the operators, the dock labour board and the union leaders on the one hand, and the dockers on the other, together with the development of welfare amenities, would further promote sound labour-management and human relations within the ports.

**Co-operation of all Interested Parties.**

The report goes on to deal with the problem of ensuring a " sufficient, but not more than sufficient, supply of labour for the efficient turn-round of ships and of allocating that manpower to the various operators in the port according to their needs."

The actual organisation of work, the introduction of new equipment, machinery or methods, and the reaction of the workers to such changes are some of the problems analysed.

In conclusion the report underlines the special importance attached by the I.L.O. to methods of improving the organisation of work and output in ports with a view to enabling ships to effect a quicker turn-round. These methods " can contribute to increasing maritime commerce, improving the conditions of work of dockers and raising the standard of living of the community in general. It is therefore desirable that all concerned—shipowners, stevedoring firms, shipping agents, port authorities, public administrations, owners and consignees of cargo, and the dockers and their organisations—should co-operate in introducing such methods."

**United Kingdom Representatives at the Meeting.**

At the time of our going to press, the list of names of the representatives of the port employers and workers of Great Britain to be present at the Hamburg meeting has been announced. It is as follows: Mr. A. W. Clarke, principal, Ministry of Transport and Civil Aviation, and Mr. J. H. Galbraith, principal, Ministry of Labour and National Service. The employers' representatives will be Mr. C. H. Brazier, director of industrial relations, British Transport Commission, and Mr. J. Morris Gifford, general manager, National Association of Port Employers. They will be accompanied by four advisers, Mr. C. Bellingham-Smith, principal assistant, International, British Employers' Confederation, Mr. G. M. Deas, establishment officer, British Road Services, Mr. S. Turner, assistant superintendent, Surrey Commercial Docks, and Mr. R. Whatling, docks' manager, Garston Docks.

The workers' representatives will be Mr. J. Campbell, member of the T.U.C. General Council and general secretary of the National Union of Railwaymen, and Mr. T. O'Leary, national secretary of the docks section, Transport and General Workers' Union. They will be accompanied by Mr. R. F. Aston, executive committee member of the National Union of Railwaymen, as adviser.

# Salvaging of Ships in Ports

## Clearing Wrecks from Harbours and Channels

By Capt. W. R. COLBECK, R.N.R.*

THE subject of the 29th Thomas Lowe Gray Lecture delivered last January before the Institution of Mechanical Engineers was " The Salvaging of Ships, with Special Reference to the Empress of Canada." The speaker was Capt. W. R. Colbeck, R.N.R. and the bulk of his lecture was devoted to the salvaging of the " Empress of Canada." An article by Capt. Hart, R.N.R., on the same subject was printed in the March 1954 issue of this journal. In the Paper under review, Capt. Colbeck also discussed the general considerations affecting harbour salvage, the growth and the existing plant of the port salvage organisation at Liverpool and the reasons why such an organisation is required. The following extracts are taken from this section of his address.

In the narrow waters of a harbour or its approaches the presence of a wreck may cause serious interference with the normal working of the port, and the prompt removal of the obstruction is of paramount importance; the saving of the vessel and cargo and the relation of cost to salved value must be a secondary consideration, although these factors will affect the methods adopted in the clearance operations.

The need to preserve carefully the navigable channels as the port developed and the numbers of vessels frequenting it increased, was recognised on the Mersey at an early date, and in 1551 the Corporation of Liverpool, the then port authority, appointed a Water Bailiff who was charged with the duty of keeping order, preventing encroachments, and removing obstructions to navigation, his powers being amended and confirmed by later Acts of Parliament. On the formation of the Mersey Docks and Harbour Board in 1858, he became an officer of that body and in 1908 the office of Water Bailiff was combined with that of the Marine Surveyor; the Marine Department today being responsible for hydrographic survey, lighthouses and buoyage, radar, the river landing stages and ocean passenger facilities as well as salvage and the enforcement of river bye-laws.

The plant of the department comprises two sea-going buoyage and salvage vessels, five camels (dumb wreck-lifting lighters) with a total lifting capacity of 2,500 tons, and a large number of portable salvage pumps and other equipment. Two new " camels " each of 1,000 tons capacity are building to replace two of the present plant which were built in 1912.

The hydrographic survey vessels the " Aestus," 125 tons displacement, one 54-ft. twin-screw diesel launch, and five 40-ft. single-screw launches all fitted with echo sounder equipment.

The S.T. " Salvor," built 1947, and her sister ship the " Vigilant " (Fig. 1), built 1953, were specially designed for service in the river and Liverpool bay and built to Lloyd's Register highest class for salvage purposes. They have a displacement of 1,000 tons and can lift a weight of 75 tons at the bow casting and 15 tons on the main derrick. Powerful fire pumps are fitted and they carry a comprehensive equipment of portable salvage pumps, diving equipment, materials for temporary patching, etc. Speed at full power is 12½ knots but they are not fitted for towing, tugs when required being provided by local towing companies under a special agreement.

The occurrence of shipping casualties in small and medium-size ports is naturally more infrequent than in a large port, and in such ports the maintenance of a harbour salvage organisation would not be justifiable on economic grounds. In large ports such as London and Liverpool, where the occurrence is inevitably more frequent and the financial loss consequent upon interference with normal traffic is large, such an organisation is necessary and will be to a large extent self-supporting, particularly when the major part of the plant and personnel can be employed on other conservancy duties when not required for salvage.

During the past ten years in the Mersey area 272 vessels, ranging in size from barges to passenger liners, have been salved or received salvage assistance. During the same period 321,512 vessels entered or left the river, the daily average for the past twelve months being 96. These figures refer to vessels on passage to and from other ports and do not cover movements from one dock to another by ocean-going vessels, tugs, and barges and the movement of dredgers, hoppers, and floating cranes. The deposit sites for dredgings are in Liverpool bay and over 60 passages to and from these sites take place every day.

### HARBOUR SALVAGE

Harbour salvage operations can be considered under two headings (1) Emergency and (2) Long Term.

**Emergency Salvage**

Emergency operations comprise assistance at collisions, strandings, or fires where the work is completed in 24 hours. The rapid provision of " first-aid " facilities under the direction of an experienced officer will frequently result in the saving of a vessel, particularly in cases of stranding or where a vessel has been beached following a collision. The tidal stream in the Mersey on spring tides attains a rate of up to 5 knots, with a range of 31-ft. between high and low water. This high current velocity causes rapid scouring of the bed material at the ends of a stranded vessel, leaving them unsupported, and several cases have occurred where the vessel has broken amidships at the second or third low water after grounding, and on at least two occasions has broken on the first low water.

A loaded ship which is making water in the cargo holds, to an amount which is beyond the capacity of her own pumps, cannot usually be dealt with quickly as it is necessary for a considerable quantity of cargo to be discharged before the pump suctions can be placed low enough in the affected hold to deal with the ingress of water.

In the early part of the 1939-45 war the Marine Department

*Marine Surveyor and Water Bailiff, Mersey Docks and Harbour Board.

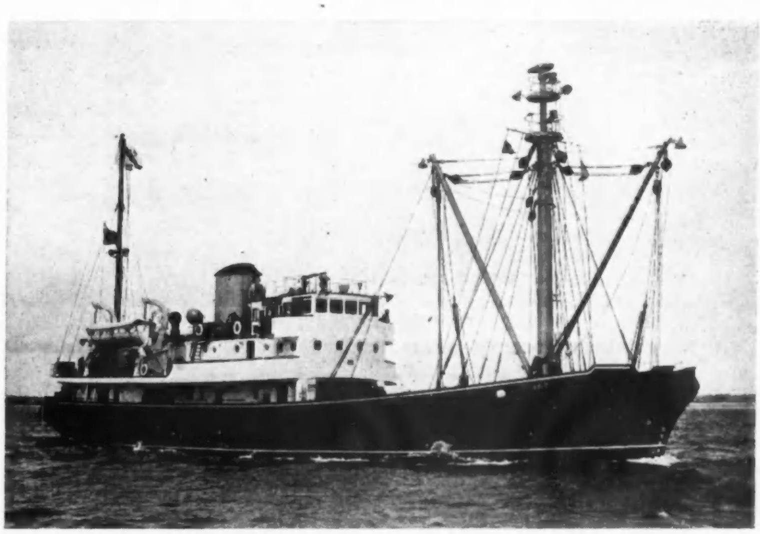


Fig. 1. S.T. " Vigilant."

## *Salvaging of Ships in Ports—continued*

made a recommendation to the Ministry of War Transport that all vessels should be fitted with a vertical trunk from the deck to the bottom of the hold, 3-ft. square, so that suctions or small submersible pumps could be used immediately even if the hold was full of cargo. These trunks were fitted in a number of vessels built during that war and, in two cases at Liverpool, were largely instrumental in the saving of the ship, but it does not appear that this fitting has continued in post-war construction.

In some cases where the damage has been in the after holds, the water has been drained into the shaft tunnel through holes punched with a Temple-Cox gun and removed from the tunnel with portable pumps. A large number of small holes are preferable to cutting a large hole as the admission of water to the tunnel can be controlled using wood rivet plugs to close the holes as required.

In ship fires the responsibility for fighting the fire rests on the senior officer of the fire brigade, but decisions as to whether the vessel is to be moved to another berth or beached and at what stage the pumping of water into the vessel is to cease to ensure that she does not capsize, remain with the port authority.

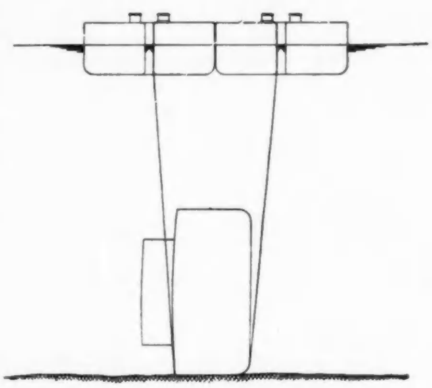
Ships in dock are working cargo or under repair, and the use of inert gas to extinguish the fire is usually precluded by the impossibility of satisfactorily closing the affected compartments or holds, and the introduction of water immediately produces stability problems. The majority, if not all, of the ship's deck and engineer officers will be off the ship, up-to-date stability information is rarely available and ship's plans are frequently incomplete, all of these factors increasing the difficulties of the operation.

The situation regarding availability of stability data is being improved by the implementation of the Merchant Shipping (Safety Convention) Act, 1949, and the recommendations of the Ministry of Transport Working Party in 1950.

The introduction of large quantities of loose water will inevitably cause the vessel to develop a list and also reduce her stability, particularly in the case of a passenger vessel on fire in the accommodation.

In deep-seated fires in cargo it is usually impossible to extinguish the fire without flooding the affected hold, and whether this can be done without risk of capsizing depends on the original stability condition.

Where a vessel of normal under-water form is lying in a berth with a depth of water below the keel amidships equal to or less than one-ninth of her beam, the risk of capsizing is very remote, as the low bilge will take the ground while the centre of gravity is still on the righting side of the line of contact. In some cases it is possible to lower the level of the water in an enclosed dock to obtain a reduced depth below the keel, alternatively if the initial stability is large it may be possible to produce sufficient bodily sinkage to reduce the depth to the desired value by flooding a single watertight compartment if this can be done fairly rapidly.



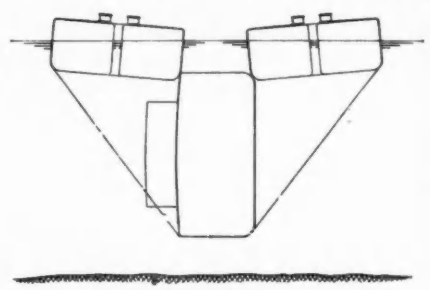


Fig. 2 (Left). Wreck-lifting with camels, centre-well pin.

Fig. 3 (Above). Wreck-lifting with camels, side pin.

**Long-term Salvage**

Long-term salvage covers operations of lifting or refloating where more protracted use of labour and plant is required and which may last for many days or months. Wreck dispersal although not strictly salvage in most instances, can be considered under this heading.

The first obligation of a port authority when a vessel sinks is to locate and mark the wreck so that it can be avoided by other vessels. When the casualty has occurred during low visibility, the position may be very approximate and an extended search by echo sounder and bottom sweep may be necessary before a wreck which is not visible at low water is fixed with sufficient accuracy to permit wreck buoys to be laid. As soon as possible an examination is made by divers to determine how the vessel is lying, and guide ropes, attached to small surface floats, are secured to various points, particularly the bow and stern.

Owing to the strength of the tidal stream, diving is only practicable in the River Mersey for short periods at the times of high and low water and, as visibility is zero at a few feet below the surface owing to the large amount of suspended matter in the water, the information available from a diver is confined to what can be ascertained by sense of touch in conjunction with the depth-gauge readings and his position determined from the surface. In spite of these difficulties, an experienced diver can provide a great deal of information.

The position in which the wreck has sunk, the nature of the sea bed and whether the area is used for anchorage are factors to be taken into account in considering whether to disperse by explosives or to lift and remove the wreck complete.

If the bottom is soft sand to a reasonable depth, it is possible to lower the wreck to below the level of the surrounding sea bed by using a series of heavy charges along each bilge, which not only shatter and collapse the ship's structure but also create a trench into which the debris settles. This method has been extensively used in the dispersal of wrecks from the last war, but, while it will produce the required navigable depth, the area is no longer usable for anchorage, and in harbours it is therefore preferable to lift and remove the wreck as a whole. The operation of cutting by explosives and removing a wreck piecemeal is protracted and costly but has been necessary in some cases.

Small and medium-size vessels are lifted by wires placed round the hull and attached to camels or pontoons, the lift being obtained either by the rise of the tide or by flooding and then pumping out the camels when the wires are made fast. When a lift is made the wreck is then moved to shallower water and the operation repeated until she is in a position when she can be patched and refloated. In most cases in deep water the vessel has turned on her side as she sank and must be uprighted as a preliminary to refloating.

The largest vessel lifted by camels on the Mersey had a displacement of 2,400 tons.

The camels are large pontoons of heavy contruction with a length of 112-ft., beam 30-ft., and moulded depth 12-ft. fitted with a boiler and two steam winches for handling lifting wires and moorings. Eight pairs of heavy bollards are fitted for securing the lifting wires which are brought on deck either over the gunwales or up through a well 68-ft. in length, running fore-and-aft on the centre-line. The use of the centre well is preferred where there is sufficient depth of water over the wreck (Fig. 2) as the breaking of one or more wires cannot cause a sudden dangerous list such as may occur when the wires are led up outside the camels' hull (Fig. 3). The latter method must, however, be used in shallow water and in the later stages of a lift from deep water.

The camels will under these conditions inevitably develop a list, partly because of the greater amount of stretch in the outside wires and the difficulty of getting them as tight before making fast as the inside wires.

Bollards are preferred to any other method, such as clamps, for securing the ends of the lifting wires, as with a trained crew it is possible to slip the wires simultaneously when under load without serious risk which cannot be done when using bolted clamps or compressors.

The largest size of wire than can be handled reasonably is 9-in. circumference with a breaking strain of 267 tons and this is used

## *Salvaging of Ships in Ports—continued*

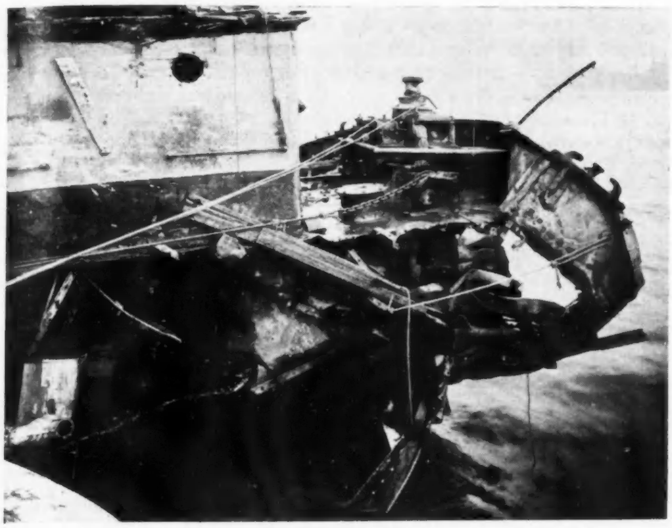


Fig. 4. S.S. "Bannprince," collision damage.

for all wreck-lifting work except small craft and barges where 6-in. wires with a breaking strain of 130 tons are used.

To position the lifting wires under the wreck, two vessels are used lying one on each side of the wreck. Each vessel has a long 4½-in. wire leading from her bow, the wires being shackled to the ends of a 30-fathom length of 1¼-in. steel chain cable which is laid out on the sea bed clear of the bow or stern of the wreck. The chain is dragged under the wreck by the vessels manœuvring alternatively, judging their positions from the marker buoys. When the first wire is in its required position, which may have to be verified by diver, a lifting wire is made fast to the end of one 4½-in. wire, and the chain and small wire are withdrawn leaving the lifting wire in its place. The ends of the lifting wire are laid out and buoyed, or passed into a camel moored over the wreck, and the operation is repeated until the requisite number of wires are in place.

It is essential that the camels are correctly positioned when tightening and securing the lifting wires so that the lead of each wire is vertical, otherwise the weight will not be evenly distributed. This entails the laying of heavy ground moorings which are recovered by the attendant salvage vessels as soon as there is sufficient strain on the lifting wires to obviate any risk of their being dragged out of place by the tidal stream.

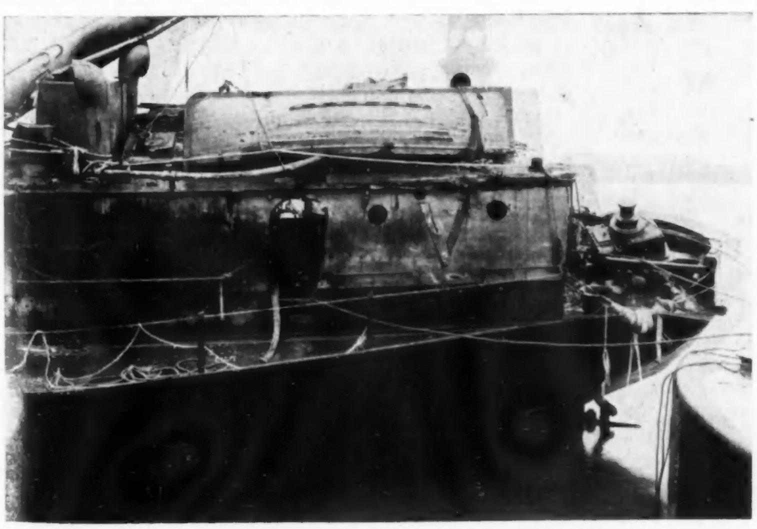


Fig. 5. S.S. "Bannprince," temporary repair.

The operation of "pinning" can only be carried out in good weather, as it is impossible to ensure an even strain on the wires if there is much movement of the camels due to sea conditions.

Several factors have to be taken into account in deciding the number and positions of lifting wires to be used on a wreck, the first being the estimated weight to be lifted and consequently the number of camels required. Excessive concentration of weight must be avoided or the shell plating of the wreck may collapse, and the positions of the wires on the camels must be balanced to obviate excessive alteration of trim. If the wreck is on her side the positions of deck houses, etc., and their strength must be taken into account as the sudden collapse of a light structure under load, releasing the weight on one or more wires, may cause the remaining wires to break If the wires have to be positioned so that they lead over bulwarks or structures that may collapse, what is termed a "breaking-in" pin is made. The wires are hove taut at low water and then checked out slowly round the bollards as the camels are lifted by the tide. Towards high water when the remaining use of the tide would produce a submersion of the camels equivalent to about half the total estimated lift required, the wires are turned up and any light obstructions are crushed.

### RECENT SALVAGE OPERATIONS

Two recent camel operations were the salvage of the S.S. "Bannprince" and G.H.D. "Mersey No. 24."

### The "Bannprince"

The "Bannprince," a coasting steamer of 569 tons gross, was in collision on 12th November 1955 when outward bound from Liverpool with a cargo of coal, and sank almost immediately. She was located about 3 hours later in the Queen's Channel about 8 miles from the mouth of the river, lying on her side in 36 feet at low water. A buoy was placed to mark the wreck but, owing to weather conditions, there was a delay of three days before operations could be started. She had sunk across the direction of the tide and the placing of six wires occupied six days. Two camels were used, the weight lifted being 375 tons. The draft on the first lift was 50-ft. and the wreck and camels were towed up channel for a distance of 2¼ miles, grounding at high water on Crosby Shoal. On the second lift at the following low water the wreck was towed a further 6½ miles and beached at high water on the west side of the river in sheltered water. Two more lifts were made before the wreck was high enough to be partly uncovered at low water when small holes were burnt in two positions in the deck and shell plating so that two 9-in. wires could be made fast by reeving through the holes and taking a turn round two frames and the deck stringer, the ends of the wires being seized to the hauling parts which were led over the port side, round the bottom, under the starboard side, and up outside the deck to the bows of the two camels. The camels were moored at right-angles to the deck, the wires made fast and, as the tide rose, the vessel was parbuckled upright. After a further lift, she was beached in a position where she dried out at low water, thirteen days after sinking. The shell plating and framing on the port side in way of the engine room had been torn out by the collision for a length of 30-ft. (Fig. 4), the opening extending down from the deck to below the light load line. The fitting of a welded patch with the requisite stiffening occupied fourteen days (Fig. 5), the remainder of the cargo which was all on the starboard side being trimmed level during this time. The "Bannprince" was refloated and entered dock for discharge of cargo on 12th December, one month after her sinking.

### "Mersey No. 24"

"Mersey No. 24," a self-propelled grab-hopper dredger, sank near the mouth of the river on 16th February, 1956, after collision, lying on her side in a depth of 62-ft. at low water and at right-angles to the tidal stream which attains a rate of 5 knots on spring tides. Considerable delays due to weather were experienced and the first lift was made thirty-three days after the sinking. Four camels with eight wires were em-

## Salvaging of Ships in Ports—*continued*

Fig. 6. G.H.D. "Mersey No. 24" and camel No. 4 beached off Egremont.

ployed, the weight of the wreck being 1,370 tons, and two further lifts brought the side of the vessel above low-water level. After the collision, her load had been slipped and the bottom doors of the hopper had to be closed and secured by divers before she could be uprighted, these operations taking five days to complete. Four camels were used for parbuckling and after three further lifts, she was beached above low-water mark (Fig. 6). The bow of the colliding vessel had cut through the shell and inner plating of the buoyancy space into the hopper (Fig. 7). Girders were fitted across the gap and watertight bulkheads constructed in the buoyancy space each side of the damage. Owing to her long period of submersion a large quantity of mud had settled in various compartments and over 600 tons had be removed prior to refloating, the vessel being docked thirty days after beaching. When the vessel capsized as she sank two of her three grab cranes, each weighing 40 tons, fell off their kingposts and these had to be recovered separately. Although they would not have been a danger to vessels under way, they formed a serious obstruction to anchorage and therefore had to be removed. The satisfactory slinging by divers in conditions of zero visibility was a difficult operation, and a vessel was occupied for ten tides before both cranes were landed.

Fig. 7. G.H.D. "Mersey No. 24," collision damage.

On account of the large range of tide at Liverpool the various dock systems are enclosed and the water level maintained at about the level of high water spring tides by pumping. When lifting by camels in the docks, it is seldom possible to lower the water level by any appreciable amount without risk of grounding other vessels, and such lifts are generally made by flooding the camels and pumping out when the wires are made fast.

The sinking of vessels in the docks by collision is generally confined to barges and small craft, and in peace time the sinking of large vessels has been due to fire except for one instance in 1947, when a passenger vessel of 8,000 gross tons sank on her side due to water entering the hull owing to the removal of ship side fittings for repair.

Capt. Colbeck then gave a detailed account of the raising of the liner "Empress of Canada" which he said was the most recent serious casualty in the docks at Liverpool and the largest wreck they had ever had to remove.

Concluding his paper, the speaker pointed out that it was impossible to cover all problems encountered in marine salvage, and many aspects, such as the employment of tugs, use of pumps, discharge of cargo, and temporary patching of damage, had been omitted. It was seldom that two salvaging operations were exactly alike and fresh problems were frequently encountered. If, as appeared possible, atomic power was adopted for the propulsion of surface vessels, the difficulties of salvage, particularly as regards safety of personnel, would be greatly enhanced. However, the basic principles would remain the same, and a successful major salvage operation was the result of the application of a knowledge of seamanship, naval architecture and mechanics of varying proportions, conditioned by experience.

# Some New Developments in Bridge Construction and Metallurgy

By L. SANDERSON

The Bailey bridge was a revolutionary departure from usual practice, the value of which was demonstrated on innumerable occasions during the Second World War. The principle was the provision of military bridges, composed of standard components, capable of erection over a wide range of spans and for various load classes.

Equally important is the civil counterpart—the standard bridge, designed also for steel construction on somewhat similar lines. The idea of standard bridges involves considerably more than merely erecting an effective bridge at relatively low expense. The cost of designing, quoting for and constructing a bridge in the orthodox manner is high, and the work required is considerable. It is, therefore, worthy of special note that standard bridges minimise the cost of drawing up special designs and making the corresponding shop drawings, making out requisitions for the rolling of special material, and constructing special templates. Estimating time is saved, while the submission of schemes, the drawing up of special erection and site plans, with the transport of steel and the completion of the bridge, are also carried out in a shorter space of time. It has been stated that in certain instances it is possible also to obtain a bridge of higher efficiency for an identical outlay.

The standards for the bridges made on this new and revolutionary principle have not been chosen at random. Data were compiled and tabulated over a period of nearly ten years, and in all respects the greatest possible economy was combined with efficient constructional practice.

The standard bridge is designed for the crossing of roads, water, rail tracks, etc. Short and medium spans are employed over a range of 24-ft. 7-in. to 213-ft. 3-in. They are obtainable in one or other of two standard loadings, and the designs are founded on unit stresses corresponding to 20,000 lb. per sq. in. in tension. The unit stresses for steels of high strength are in agreement with the acknowledged practice of the principal engineers. For the actual construction two types of steel are used, one being rolled carbon steel to a standard specification and the other a high strength steel.

Six types of standard bridges are available, each in a different length as desired. They comprise beam bridges, deck girder bridges, pony truss bridges, deck truss bridges, through truss bridges and adaptable span road bridges. These last are adjustable in length and are of single lane type for either temporary or permanent use with timber, concrete or steel grid floors. They are especially useful for experimental or development work in which it is desired to determine the fundamental conditions, the

## *Some New Developments in Bridge Construction—continued*

actual requirements not being known. Such bridges also fulfil the demand for a temporary or permanent bridge designed to take the place of one undergoing repair or which has been destroyed or has become dangerous.

The bridges are composed of interchangeable members so that adaptation to various lengths of bridge is possible. Thus, the members of the basic standard structure of 120-ft., centre to centre of bearings, may be employed to build a 90-ft. span or two 60-ft. spans using one extra floor beam. Field connections are minimised and normal bolts only are employed, there being no need for rivets or welds.

There is no difficulty in putting up the bridges by either false work, overhead trolley systems, etc., or a specially constructed launching nose can be used, i.e. a light-weight trussed structure, 80-ft. long. This nose weighs 14 tons and in the case of a river, is assembled on the bank. As soon as the first section of the bridge is fabricated, the nose is secured at the end facing the stream. As bridge sections are completed, the nose and the structure secured to it are rolled out over the stream, the weight of the assembled bridge sections balancing the launching nose. On land the nose and bridge are on pipe rollers mounted on heavy pedestals. The rollers are equivalent to the greased ways for the launching of a vessel; but in this instance the bridge is launched over the river as the result of a thrust from tractor or lorry.

For short road span bridges, standard beam bridges are particularly suitable, having a range from 20-ft. $7\frac{1}{2}$-in. to 57-ft. 5-in. Very little constructional shop work is called for, and erection is facilitated by simple field connections. The relatively light weights of each single piece and the low cubic measurement as compared to deadweight, mean that transport charges are low.

For spans exceeding the range of beam bridges and where the restricted under-clearance makes it impracticable to employ the deck truss type of bridge, deck girder bridges are made. These are built in four different lengths, ranging from 49-ft. $2\frac{1}{2}$-in. to 80-ft. $0\frac{1}{4}$-in.

Pony truss bridges are usually better than either beam or plate girder bridges by reason of the short lengths and relatively low weight of the separate parts. The small dimensions of the members make transport easy and allow erection with the least amount of plant. Six standard bridges are obtainable in range from 49-ft. $2\frac{1}{2}$-in. to 114-ft. $9\frac{3}{4}$-in.

Assuming there is adequate under-clearance, the deck truss bridge is employed because of its greater economy than the through truss bridge, and because it is possible to lessen the distance between trusses and abbreviate the lateral members. Five standard lengths are made, ranging from 98-ft. $5\frac{1}{4}$-in. to 164-ft.

For spans of about 98-ft. or more, assuming that there is not enough under-clearance to allow the employment of deck types, the through truss bridge is employed. Four standard bridges are made with a range 98-ft. $5\frac{1}{4}$-in. to 147-ft. $7\frac{7}{8}$-in. These are constructed with parallel chords. There are also four standard through truss spans ranging from 164-ft. to 213-ft. $3\frac{3}{8}$-in. with curved top chords.

The bridges are of American origin, and are being pioneered by the United States Steel Export Co., New York, but there is reason to believe that before long equivalent types of British steel standard bridges may be put on the market.

Another development is the technique of building the arches of a bridge last. In one instance the arch ties and floor system for a three-rib arch steel bridge were constructed first and supported by falsework. A derrick then erected the arch ribs and hangers. As soon as the ribs were finished, they were joined to the ties, the hangers remaining detached from the floor system. Jacks attached to the hangers then drew the floor system up until it could be attached to the hangers.

High winds and deep water eliminated normal techniques in putting up 28 steel deck truss spans in a large bridge, and as a result an aluminium falsework truss was adopted. This was light enough to be lifted into position by equipment already on site for other functions. Two 117-ton aluminium spans were made. Temporary timber bents on the concrete piers carried the aluminium truss. The next step was to raise the span on to the bents. Floating equipment was employed on the first span, but the following spans were all lifted by a hoisting rig and a traveller mounted on the floor beams of the previously erected span

As soon as the aluminium span was in position, the steel span was erected on top with the traveller. Jacks lowered the finished span from the aluminium truss to the steel piers. The aluminium truss was then lowered on to a barge, moved between the next two piers. and elevated into place.

As regards metallurgical developments; during recent years new and often rare metals have assumed considerable importance. This is because many of them possess unique and remarkable qualities which makes them essential raw materials in the fields of atomic energy and electronics.

At the same time, as a result of research, many of the more common and better known metals are being used successfully as alloying materials with steel which thus, with many characteristics, finds a wide variety of important applications.

In this latter field development progress has been steady, if not sensational, and besides the advent of aluminium alloy steel some interesting and important advances have been made with steels alloyed with nickel, copper, chromium and manganese. Some of the more recent examples are briefly referred to in the following lines.

In a new harbour bridge, the plans called for an open grid steel flooring, but at a later stage the plans were changed to include a solid floor on the truss spans. This greatly complicated matters by adding 39 lb. per sq. ft. or a total of 864 tons dead load, to the superstructure. The originally specified carbon steel structure would not support this additional weight. In consequence a nickel manganese copper steel was adopted. This high strength low alloy steel is capable of giving a minimum yield point of 22 tons per sq. in. and a minimum tensile strength of 31 tons per sq. in. in thicknesses $\frac{3}{4}$-in. and under. The minimum yield point is, in fact, more than $1\frac{1}{2}$ times that of structural carbon steel. Costly changes in connections were unnecessary, and at the same time ample strength and safety were provided. Only 550 tons of steel were required as compared with 730 tons if carbon steel had been used.

Another new engineering material recently introduced brings to wider fields of application the corrosion-resisting properties of the high nickel alloy cast metals. It shows a marked improvement over the ordinary nickel chromium alloy cast iron in strength, toughness and other mechanical properties, and is, in fact, a ductile type of alloy cast iron. It is produced by treating cast iron with magnesium, which creates a minimum number of discontinuities in the metal and produces a stronger, tougher and ductile material. The mechanical properties of the new material are essentially: tensile strength 26 to 30 tons per sq. in., yield point at 0.2 per cent. offset, 14 to 16 tons per sq. in., elongation 8 to 20 per cent. Corrosion resistance is unimpaired, and the material resists erosion and wear, having also low temperature stability, heat-resistance, controlled expansivity, castability and machinability.

The boom on a floating crane has recently been manufactured from a high strength nickel alloy steel. The boom would have weighed 55 tons if made of carbon steel, whereas its actual weight is 35 tons. It will lift 150 tons at the 85-ft. radius block and 50 tons at the end of the boom.

Nickel copper chromium high strength low alloy steel is being applied to lock gates. The alloy steel gives improved resistance to corrosion, weldability and adequate mechanical properties. A new idea to discourage barnacles from settling on piers and piles, as well as ships' hulls, has recently been tried out successfully. Ultrasonic vibrations, induced through a transducer, make the piles an uncomfortable place for barnacles to settle. Nickel plates used in the transducer are primarily responsible for creating the ultrasonic vibrations owing to the fact that nickel changes in dimensions when magnetised and reverts to its original size when demagnetised. When this is done at high frequency, vibrations are produced from the nickel plates.

High strength bolts have proved that they can save time and cut costs, for joining structural steel timbers. These bolts can be tightened up to the yield strength of the steel, so that a 1-in. steel bolt will develop 19 tons tension, nearly twice as much as a rivet. The frictional resistance between the plates of a bolted joint is therefore nearly twice as great as that of a comparable rivet joint.

## *Some New Developments in Bridge Construction—continued*

The built-in physical properties of the bolts are not affected by weather or workmanship. Because of its greater strength, a structural joint subjected to repeated or reversed loading will show a higher resistance to failure when fabricated with bolting, while high strength bolts can be used where a high level of joint rigidity is needed. These bolts also assist in easing concentrations of stress that might cause failure of the joint. They must be accurately tightened, and are made of a high tensile steel material.

New low alloy steels have been developed suitable for welding and having high strength. They are low in carbon content, being alloyed with manganese 0.8 to 1.2 per cent., silicon 0.5 to 1 per cent., chromium 0.6 to 1.1 per cent., nickel 0.5 to 1.5 per cent., with small molybdenum and vanadium contents. The steels show excellent resistance to brittle fracture.

A multi-purpose welding electrode has been designed to fill the need for a rod capable of making strong, ductile joints between a large range of metals of substantially different compositions. The weld metal deposited is of adequate strength, ductility and freedom from cracks in spite of dilution by dissimilar combinations, and is also operable in a vertical position, with the slag readily removable and the welds free from gasholes. In corrosion properties the weld deposit is said to be superior in most instances to the parent metals.

The use of dry steam for preparing the surfaces of steel or cast iron for painting is being successfully adopted in many directions. The cost may be only 75 per cent. of that for chemical treatment, and no entrapped chemicals can cause trouble from bleeding after painting. Clean parts are loaded into a pressure furnace and treated with steam. Steel parts need about 1 hr. at 400 deg. C. and cast iron parts 650 deg. C. for a somewhat longer period.

A new type of metallic coating for the roofs of industrial buildings combines in a single coat the excellent waterproofing qualities of black roofing materials together with the attractive finish of a bright aluminium paint. The aluminium pigment "flakes" to the surface, producing a brilliant finish which reflects up to 80 per cent. of the sun's rays. Laboratory and field tests are said to show that temperatures within a building can be reduced by as much as 24 degrees. An application of the new coating is claimed to be equivalent to ten heavy coats of paint, and to stop leaks in any roof immediately on application.

The loads required to be lifted in docks and harbours steadily grow larger and this is being met by the increasing adoption of heat-treatable nickel alloy steel chains. The steel used is capable of giving a tensile strength of 56 tons per sq. in., an elongation of 15 per cent. minimum and a hardness of 25 to 29 Rockwell C. The new chain can be formed and welded successfully and is consistently strong, tough, yet ductile. It can be successfully forged into hooks and other special attachments. Welding is always done before heat-treatment. It is claimed that a length of modern alloy steel chain will safely lift nearly twice as heavy a load as unalloyed chain. In fact, 1½-in. alloy steel chain is safely replacing 2-in. wrought iron chain in risky lifting applications. Additional advantages are greater mobility of the chain, reduced freight and storage space, and reduced dead weight per lift. The saving of weight is said to be of the order of nearly 70 per cent.

Pumps on suction dredgers undergo heavy punishment, having to suck up sand, sludge, gravel and rocks of various sizes, so that failures as a result of abrasion are not uncommon. In one instance a rock tore a large hole in a cast iron pump casing weighing 4,300 lb. despite the 2-in. thick cast shell. Instead of scrapping this seemingly useless casing, it was reconditioned by welding. A steel plate was first fitted over the hole, and the aperture was welded with special nickel electrodes of 3/32-in. diameter. The entire job took six hours and needed altogether 10 lb. of electrodes. Considerable saving in cost resulted. These special nickel rods, whether of austenitic nickel chromium cast iron, ductile iron or low alloy iron, are all designed to weld cast iron to itself or other metals. They give sound and machinable deposits, and are invaluable for emergency repairs and the building up of worn surfaces.

A different salvaging method has been adopted for rebuilding broken or worn dredger equipment. A cutterhead for a 12-in. suction dredger was broken across the back rim, three tie braces also being broken loose from the cutter blades, while the blades were worn to a minimum width of 3-in. In fact, the head was useless. To rebuild it, cast steel dipper tooth bars were welded to the worn blades with a nickel manganese steel welding rod. The cutting edges of the bars or blades were then hard-surfaced with a special type of hard metal. When the work was completed, the rebuilt head was equal to a new one at half the cost.

A most unusual development is a material that handles like modelling clay, yet hardens two hours later into a rigid, tough, steel-like mass. It is a combination of 80 per cent. steel and 20 per cent. plastic and is easy to use. All that is required is to add a special hardening agent to the plastic steel mixture, stir it with a screwdriver, and press or pour it into the required shape. No heat or pressure is required. Once hard, the material can be sawn, drilled, threaded or ground with ordinary equipment. It is being used for filling large or small holes in metal parts, in bonding steel to itself or to other materials, and in building up the interior of pumps, valves and other worn sections. The material can be supplied either as a putty or as a viscous liquid. There is virtually no shrinkage during hardening, and once set the material is both durable and permanent.

To protect reinforced concrete wharves from damage by tankers, steel buffer piles are sometimes driven into place around them. Such piles are now being sheathed with high nickel copper alloy metal to a height of 6-ft. The rolled steel joists are boxed in with mild steel to form an air-tight seal at the wind and water line. These boxed-in sections are then encased in the alloy metal sheet to protect them permanently against corrosion.

A metallic plastic patch has been invented for the repair of ruptured or damaged water piping. It is easily applied and can put a piping system back into operation in about half an hour. The patch can be used on most types of ruptures, including a severed section of pipe that has been completely separated, a ruptured elbow located on any curved section of pipe, a compound rupture with protruding edges or ruptures in fittings. It should be used only on salt or fresh-water piping where pressure does not exceed 300 lb. or where temperature is not above 100 deg. C. Experiments are being carried out with a view to applying the patch to steam, petrol and other pipe lines. The patch takes 15 to 20 minutes to apply, and pressure can be restored to the system within 20 minutes after application. It will last until permanent repairs can be made.

## Institution of Civil Engineers

### Sir Arthur Whitaker Elected President for 1957

Following the death of Mr. H. J. F. Gourley in December last, the Institution of Civil Engineers have recently announced the election of Sir Arthur Whitaker as president of the Institution for the remainder of the year.

Sir Arthur has had long experience in the field of civil engineering and was, for many years, Civil Engineer-in-Chief to the Admiralty. He is now a partner in the firm of Livesey and Henderson, consulting engineers. He was born in 1893 and educated at Liverpool Institute High School and Liverpool University, where he graduated B.Eng. in 1914 with first-class Honours, becoming a M.Eng. in 1917.

In 1915 he joined the Civil Engineer-in-Chief's Department, Admiralty, at H.M. Dockyard, Rosyth, and was connected with the construction of that base for the remainder of the First World War. Subsequently, he served in Jamaica, Malta, Portsmouth and Singapore, and was stationed at the latter base during the height of its engineering development. He returned as Deputy Civil Engineer-in-Chief in 1934 and, in January 1940, became Civil Engineer-in-Chief, which post he held until his retirement from Government service in 1954. He was responsible to the Board of Admiralty for all civil engineering works connected with the dockyards and naval bases at home and abroad, for the extensive construction of Royal Navy air bases, armament depots and preparations in connection with the invasion of Europe during the Second World War. He also assisted in many other major developments.

He was created Knight Commander of the British Empire in 1945 and Commander, Legion of Honour, in 1947. In view of his extensive knowledge of maritime works, he was invited to become a member of the International Consultative Works Committee of the Suez Canal Company in 1952 and, in 1953, he was elected a vice-president of the Institution of Civil Engineers.